SUPPLEMENT

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Parliamentary Intelligence.

HOUSE OF COMMONS.

(Before Mr. KNIGHT, *Chairman; Mr.* GORE LANGTON, *Mr.* MCEVOY, *and Capt.* KEARSLEY.)

NEATH NEW GAS BILL.

MONDAY, MAY 7.

Mr. RODWELL, Q.C., Mr. RICHARDS, and Mr. THOMAS, appeared for the promoters in this case; and Mr. BURKE, Q.C., and Mr. MICHAEL, for the petitioners, the existing gas company at Neath.

Mr. RICHARDS (in the absence of Mr. Rodwell, Q.C.) opened the case on behalf of the promoters. He said the bill which was brought before the committee was a bill for granting certain powers to the Neath New Gas Company, Limited. The preamble stated that in the year 1865 certain persons formed themselves under the name of the Neath New Gas Company, for the purpose of supplying the town of Neath with gas. Suitable land had been purchased for the site of the works, and the capital of the company, amounting to £10,000, was divided into 5000 shares of £2 each. Of that number of shares 2915 had been subscribed for.

Mr. RODWELL having arrived, at once proceeded with the case. He said the object of the bill, as the committee probably were aware, was for enabling the existing limited gas company, who had already got their deed of corporation, to acquire a site for the purposes of their works. Now, there was a little history, which he would very shortly state, with regard to the Neath gas. A little company had been formed in February, 1832, and there was a deed of settlement by which they had a certain amount of capital—£1800, in shares of £50 each. At that time gas-works were a matter of speculation, and as to the charges which the company made upon the inhabitants no doubt they were high; but he ought to state that as the matter was at first experimental, this state of things was somewhat accounted for. As time went on the works were increased proportionably, and the price subsequently charged was 7s. per 1000 cubic feet. Matters thus went on from 1832 till 1860, when the price was reduced to the sum of 5s. Now, with the price of coal in Neath at 8s. 6d. per ton, the price of gas was considered to be exorbitant, but as the company was the only one that existed at Neath, the public were obliged to submit, and the dissatisfaction which was and had since been felt led to the formation of the new company, and the existence of the present bill. Although the price had been reduced, which had somewhat allayed the dissatisfaction which at one time existed, the gas supplied had been bad in quality, the public lights had been very indifferently served, and, in addition to that, there were objections to the site of the works, which still were situated at that extreme corner of the town where they were placed in 1832. That part of the town was thickly inhabited, so that if the company wished to extend their works objections would be raised against their doing so in a sanitary point of view. The object of the present company was to increase the supply of gas to the town, and to place their works on a site where no buildings would be near it. The new company, as he had before stated, was a limited company, and already for the purpose of their works three-fifths of the capital had been subscribed for in the town and neighbourhood, and he might say that, in addition to those three-fifths, there would be no difficulty whatever in obtaining the remaining two-fifths towards the construction of the works. The formation of the new company had been well received by the public of Neath. The corporation had met upon the subject, and in March last they passed a resolution in favour of the scheme. At their meeting in March it was resolved to affix the seal of the corporation to a resolution in favour of the company, and afterwards a petition was approved of and signed by the chairman respecting it. In that petition it was stated that the gas which was then supplied to the town of Neath was unsatisfactory, and the quality of its illuminating power bad; and it was set forth that by reason of the company not being under legislative control there was no power over them which could compel them to remove the grievance. That which he had stated really seemed to him to be his case. The corporation and the public, too, had stated what their views were upon the matter, and that would be used as evidence in his case, for the purpose of showing the ground upon which the promoters came before Parliament for their bill. Besides the petition of the corporation, there had been another from the gas inspectors of the town in favour of the scheme. Those gentlemen, who were appointed to regulate the gas supplied to the public lamps, met on April 2nd, when a petition was adopted in favour of the new company, it being signed by five out of the nine inspectors then present. Then, there was also a petition from the ratepayers and inhabitants of the town, about 900 persons in number, who represented property, the rateable value of which was of very considerable value, and all those persons said that the present supply of gas was inadequate and unsatisfactory, and in quality bad; and, however, they asserted that, as the present company were not under any parliamentary control, they, as consumers, had no means of testing the purity of the article supplied. These things, the learned counsel contended, showed pretty well what the feeling was with regard to the manner in which the present company supplied the town. He had been told that the value of the property belonging to those who had petitioned in favour of the bill was about 11-15ths of the whole property of the town. The committee then would see that the promoters of the bill were supported by a numerously signed petition from the inhabitants. The corporation asked them to interfere and to remove a state of things which was intolerable, and besides this, the committee would be pleased to observe that the new company was not a speculative one; it was not one of those that were got up by gas engineers and contractors, but was a *bonâ fide* one, with the whole of its capital, or nearly so, subscribed. If the bill was passed, there would be, undoubtedly, a better supply of gas to the town; its purity would be improved; and they asked the committee to grant them what they sought, believing they were entitled to the provisions laid down in the general law and which were incorporated in their present bill. The present company, not having parliamentary sanction, had no power to take up the streets for the purpose of laying down new mains; and in consequence of their limited area they were unable to supply the increasing demands of the public; they were unable to take their mains in any particular locality; but for that which they did supply they could charge what they pleased. The promoters of the bill were ready and willing to supply a good article, and would also undertake not to charge more than 4s. 2d. per 1000 feet. That would be their *maximum* charge, and that probably would be reduced to something less. At all events, this state of things existed—the present company had no power to supply the inhabitants with the gas they required; the people were without protection, and it was desirable that this state of things should no longer continue. The promoters did not hesitate to say that they would be prepared to supply the town with gas that was undeniable in quality, and, by clothing themselves with powers, they would be able to afford such supply as would be necessary to meet the requirements of the town. The present company, or rather association he might call them, had not thought proper when the new company expressed their opinion of coming to Parliament to do the same thing, and he might say that as every publicity had been given to the scheme they could not be unaware of it. In conclusion, the learned counsel said that Neath was a large, growing district, which at the present was very inadequately supplied with gas. The quality of that gas was bad, and the quantity not at all sufficient to meet the requirements of the town. To meet these things, the present company were prepared to supply the best article, and at the very lowest possible price. They wished to see Neath have those comforts in lighting which other towns of the like size and importance in the kingdom now enjoyed. With regard to the medical report, he did not propose then to read that *in extenso*, but he might observe that a very able report on the present gas-works had been made by a gentleman who was a member of the Royal College of Surgeons, and who stated that it must be obvious to everybody that the existence of the present works was a great nuisance to the town, and that they could not be extended without seriously affecting the health of the public. The site for which the new company now asked power to acquire was admirably adapted for the purpose of gas-works; it was conveniently situated, the drainage was good, and there was a convenient mode of getting rid of the refuse matter, which was not the case in the old works. He had great confidence in his case, and on behalf of the promoters would not shrink from any inquiry with regard to the matter. They were prepared with the requisite capital, and they would undertake to supply an article which in quality the inhabitants could not now obtain, and at a price which could not reasonably be objected to. In opposition to the scheme there was, he believed, a petition to be presented on behalf of the shareholders of the present association. They raised a general issue, but there were certain points on which he did not hesitate to say there was a great deal of imagination, and of the whole there would, perhaps, be only one or two that the petitioners would be able to establish against them. When all things were considered, he thought that the committee would see that the opposition was one to which they would attach but very little importance whatever.

TUESDAY, MAY 8.

Mr. *Sankey Gardener*, examined by Mr. RICHARDS.

I am an ironfounder at Neath, where I have been in business upwards of 35 years, and am alderman, and have been mayor of the borough. In February, 1835, I was elected one of the nine gas inspectors of the borough, who are appointed under 3rd and 4th William IV. The office is held for three years, and I have been continually re-elected. I have thus been brought in contact with the gas lighting of the parish. Neath was first lit with gas in 1833, by the Neath Gaslight and Coke Company. They are a private company, under no parliamentary restrictions, and with no parliamentary powers. After a time they entered into a lease with Mr. Bonville, and he, as their lessee, lighted the town for some yards. During his lease the public lamps were charged £3 per annum each. In July, 1861, the association or company resumed the lighting, by an arrangement with Mr. Bonville. Upon that the charge for the public lights was raised, I believe, to £3 5s., and it stands, I believe, at that now. There was a certain number of hours stated during which the lamps which to be kept lit. There was no written contract. During the time the company have carried on the public lighting it has been very unsatisfactory, and therefore we have declined to make any contract; it has merely gone on from year to year. They light the lamps within half an hour from sunset to sunrise, I think. The quality has constantly been complained of, and the quantity, too. I attend the meetings of the gas inspectors regularly, particularly of late. During the last nine or ten years there have been very frequent complaints made of the gas; individual consumers make complaints; the complaints are very general. The superintendent of police attends these meetings, and presents reports of the state of the public lights. The letters produced, dated 1861, 1862, and 1863 are fair samples of his reports. It is his duty to complain of insufficient power.

Mr. MICHAEL objected that the agency of the superintendent must be proved.

Witness said the corporation had given him leave to come up to give

evidence, and on the last occasion he was present, but the bill did not come on.

The CHAIRMAN said he thought the witness might put in the report which he had received.

Mr. MICHAEL objected to the report being received unless the superintendent were present to be cross-examined.

Mr. RICHARDS said such matters were always received in committee. It was simply a question whether the witness had received complaints from a certain public officer.

Witness: I have.

Examination continued: Those complaints took the form of letters. The superintendent received instructions from the corporation to attend to those matters, and he attended every monthly meeting of the inspectors, and made reports. After such reports, representations were made to the association; some of them were in writing; I have not got copies. I am a consumer of gas in my private house, and also in my place of business. During the last 10 years the illuminating power has been, I think, very bad. I am not a chemist, but I have seen much better gas elsewhere. The quantity has been very irregular. At my residence very frequently all the lights went out. It has not been so in my place of business. They are on about the same level, but the former is further from the gas-works.

The CHAIRMAN said the committee had decided upon referring the question of supply, price, illuminating power, &c., of the existing works to the referees, and under Standing Order 97, if the opponents and promoters agreed to it, the whole question might be taken before the referees, which would save hearing a good deal of evidence twice over. They were obliged to hear the promoters open their case, but when the opponents brought forward their rebutting evidence, it would be referred to the referees. If, therefore, they agreed to take it all there at once it would be a saving of time.

Mr. RICHARDS said he understood that those Standing Orders were framed with reference to new companies. It had never occurred to him that the case would be so cut up between two tribunals.

A member of the committee said it was only on a particular part of the case, unless by consent of both parties.

Mr. RICHARDS said the opponents had endorsed their petition for the referees, and the promoters had been at the expense of bringing up ten witnesses from Neath to meet the case, and then they withdrew the petition before the referees, so that on these points it was practically an unopposed bill. If the committee decided that these matters were questions for the referees, then he submitted that the opponents were shut out from going with them by withdrawing their petition.

Mr. MICHAEL said it was impossible for an existing company to test an inchoate company as to the quality, price, and quantity of their gas. As in other cases, it was a mere formal endorsement, and his friend had notice that the case would not be gone into before the referees.

Mr. RICHARDS said that as soon as any of these points were touched upon, he should contend that the opponents were excluded.

The CHAIRMAN said it was only referable to the referees under Standing Order 97, by consent of the chairman of the Committee of Ways and Means, which had been given; but if both parties agreed to do so, by Standing Order 94, the whole matter might be considered by the referees, who would report to the House; and if they reported that it ought to be proceeded with, it would be treated as an unopposed bill. This, however, could only be by consent.

Mr. RODWELL said, as the committee had thrown out this suggestion, and as they had decided upon sending a portion of the question to the referees, it would be more respectful to adopt the course proposed.

The CHAIRMAN said it appeared to the committee that it would save time.

Mr. RICHARDS said no doubt that was a desirable object to keep in view.

Mr. BURKE said he would agree to the proposition of the committee, and take the whole matter before the referees.

It was also arranged to adopt the same course with the Worksop and Shirecoaks Bill.

THURSDAY, MAY 10.

(*Before the Referees—Mr.* SCOURFIELD, *Chairman; Sir* W. G. CRAIG, *and Mr.* HASSARD.)

Mr. RICHARDS and Mr. THOMAS appeared for the promoters; Mr. BURKE, Q.C., and Mr. MICHAEL, for the opponents.

Mr. RICHARDS said that the bill which was then to be considered by the referees was a bill for better lighting the town of Neath. The company had purchased land whereon to erect their works, and they were about starting with a capital of £10,000, in shares of £2 each, a considerable number of which had already been subscribed for. The town was at present lighted by what he might call a partnership or association of gentlemen, who had been for some years associated together for that purpose. But, whilst they supplied the town with gas, they had no power to open the roads, and were under no sort of restriction as to the quality of the gas they supplied, the amount of pressure, illuminating power, and so forth. They became associated about the year 1832, and consisted of about 17 persons. They had a Deed of Settlement, and their capital was £1800, in shares of £50 each. They erected small works, and commenced lighting the town in 1833. There was no other gas company, and they contracted for the public lighting, and also for supplying private consumers with their gas. They charged for the public lights at the rate of £2 10*s.* each per annum; and they supplied private consumers on scale charge, or so much per annum. They went on till about 1847, when they appeared to have entered into a fresh contract, and their capital was increased to £3000. They then entered into an agreement with Messrs. Bonville to become lessees of their works, and they supplied the town for some time, when the price charged was gradually increased till it came to 5*s.* per 1000 cubic feet. Matters then continued till the association thought well to retake the works into their own hands; and by an arrangement made between them and Messrs. Bonville, the latter surrendered their lease, and the association again commenced lighting the town. The first thing they did, though he could not say under what circumstances they were justified in doing it, was to raise the price charged for the public lights to £3 5*s.* per annum. Since that time the association had raised additional capital, increased their works, and laid down additional mains. The present gas-works were situated in a part of the town where there was a large population, and they were much surrounded by houses; so much so, that there were no facilities for extending them. The association in the conduct of their business had exhibited almost every defect which it was possible to conceive, for not only had there been a deficient supply of gas, but the pressure had not been at all what it ought to be, whilst the price charge was much too high, considering that Neath was situated in a coalfield, where coal could be had at 8*s.* per ton. The public lights had been extremely ill-served, and the works were badly constructed, and ill-adapted by their position for the purpose; and, moreover, there was no room for their extension. One of the complaints which had for some time existed against the association was caused by the habit which they had of requiring an incoming tenant to pay a debt contracted by his predecessor; in fact, they seemed to think that a debt for gas was attached to the freehold. No doubt many years ago such a notion prevailed over a considerable portion of this country, but it could no longer be tolerated, as such was not now the law of the land; and certainly the promoters thought they had a substantial ground of complaint when they found gentlemen following out a practice which was extinct. Another complaint was—and it was just one of those out-of-the-way things which companies or associations unrestricted by parliamentary obligations appeared to do—they would not supply any persons with gas who did not purchase their fittings from them, and even would not put their gas on; besides which, they insisted upon their men putting up the fittings, and if they were not so employed they made a charge or extra payments, which were equivalent to it. Again, there were other complaints, which were made more particularly by the public bodies, as to their not properly restoring the public roads after they had laid down their mains. They laid down their pipes in contact with the water-pipes, and so caused much trouble and great inconvenience to the public. As to the deficient quantity of the gas, the complaints were almost universal, as were also the complaints as to the deficiency in illuminating power of the gas which the association supplied. This state of things led to the formation of a new company, who were backed strongly by petitions from the corporation and the gas inspectors of the town, and those gentlemen of course were peculiarly in a position to form an opinion, and he believed the court would find they had great cause to complain. They petitioned in favour of the new bill, and the ratepayers also petitioned in large numbers. Of the £15,000 of rateable value, the petitioners represented fully £11,500, which was a very large proportion. On the other hand, there was but one petition against the bill, and that was from a body of gentlemen who were more or less connected with the present company. Of course they took care to call themselves ratepayers as well as shareholders. They said, in fact, they were a company established in 1863 for the purpose of supplying the town with gas. They had, however, no deed of incorporation; they were not even registered; and he should submit they had no *locus standi*.

The COURT said they would discuss that question after they had heard the evidence.

Mr. RICHARDS would simply say that, assuming those gentlemen supplied the best gas in England, and performed their duty properly in every way, it was no answer that they should say to a body of gentlemen who came forward to establish a company in that town, "We are a partnership already established here." He maintained that they had no existence which the court could recognize. The petitioners also said that they had expended large sums of money on their works, that the works had not been remunerative, and that with a view of remedying certain defects in the manner in which the town had at one time been supplied, they had purchased at great expense the surrender of their lease; that since they had the works in their own hands the gas had improved, that for a long period they had supplied the town with gas at a cheaper rate than was charged in other towns, that there was no excuse for invading their district, and that in fact the town of Neath was too small to admit of a division. All these allegations were very well in their place, but they were not to be substantiated, and therefore he would not trouble the court with any lengthened observations upon them. He would merely observe that the promoters wished to place themselves under all ordinary parliamentary restrictions; they proposed to charge as the maximum 4*s.* 2*d.* per 1000 feet, and to give gas of an illuminating power equal to 14 candles, which was the prevailing illuminating power over the greater part of England. Should the bill pass, which he hoped the court would see fit to do, the inhabitants would have the power of getting what was only now professed to be given—good gas at a cheap rate; and, moreover, they would be relieved of the monopoly which the association had for so long a period enjoyed.

Mr. *S. Gardener*, examined by Mr. THOMAS.

I am an ironmonger, residing in Neath. I have been mayor several times, and now am alderman, and have filled several offices in the town. Have been elected gas inspector several times. No inspectors are appointed under the General Watching and Lighting Act. The whole of the town is in one parish, and it has increased in population considerably of late years. There are four railways from the town, two stations, and large tin, chemical, and other works there. The town was first lighted with gas in 1833, by the present proprietors. The works at one time were leased to Messrs. Bonville. The price then charged to the public was 60*s.* per annum. In 1861 the lease was surrendered to the proprietors, and the price to the public lamps was increased to 65*s.*, and it has continued so from that time to the present. The supply is furnished from year to year without contract. The contract was not renewed on account of the complaints of the inspectors as to the deficient supply, and the want of illuminating power. A good many complaints were made as to the manner in which the public lights were supplied. The site of the present works has about it a dense population of the lowest class, and is not an eligible site for the manufacture of gas. Any extension of the works would greatly increase the evil; that is the general feeling of the town. I myself am not satisfied with the general quality of gas supplied to me. I cannot speak as to the purity. The lights in my private dwelling at times suddenly go out, which I suppose is owing to the want of pressure or deficient supply. I believe that matters would be remedied if a new company were stated, and placed under parliamentary restrictions. I am a director of the new company. Three-fourths of the ratepayers have signed a petition in favour of it.

Cross-examined by Mr. BURKE: My son has signed the petition. His age is 23. He is not a householder. Never heard of any boys signing the petition. I do not know Thomas John Hutchings, or William Hutchings, junior, chemist's assistants. The population of Neath exceeds 9000. I believe the present gas company is not able to supply the demand which now exists. We have had large works erected in the town of late, giving employment to several hundreds of men. The company have been unable on several occasions to supply gas when required. We proposed to light a public road, as they were unable to do it. The company have complained of not being able to lay down their pipes, which they said were lying on the ground in Windsor Street, and were becoming rusty. The inspectors have imposed no impediments, but the surveyor of roads has appeared to be unwilling to allow the company to disturb the roads unless they paid down a certain sum towards the roads being made good again. The company's works are not sufficient to supply the increased demand made upon them for gas. I do not know that the company have laid out large sums of money since 1861, when there was a resumption of their lease, or that they have expressed their readiness to increase their supply. We did require them to light the public lamps a longer time than they did before, and that might be the reason why they increased the charge. I have made no test myself of the illuminating power, but I say that the gas has not been good. The coal that has been used requires a mixture of another kind—cannel coal. I pay 8*s.* 6*d.* to 9*s.* per ton for household coal. We do not propose buying our coal of Mr. Kenway. The coal we intend to buy has been tested. I cannot say whether it is strongly impregnated with sulphur, or that it is of the commonest kind. It

has not been tested as to its illuminating power. In one part of my house the gas will go out, but not in another. The pressure is less when the shops and places of business are closed of an evening. I have observed that then my lights will decrease in illuminating power. There can be no doubt as to the objectionable state of the works. I cannot say whether the corporation intend removing them as a nuisance or not. I think works on the proposed site will be no nuisance at all. It is far removed from any dwelling. There is a popular belief that the prevailing winds are from the south-west. Our works will be at the west end of the town. I cannot say that the effluvia from them will be blown over the town. The greatest evil arises when there is no wind at all; for then the population suffer very much. Our profits on subscription contracts I believe will be such as will pay us, charging a maximum price of 4s. per 1000 feet. I do not think that the gas inspectors as a body have signed in favour of the bill. There are nine of them altogether. I am a member of the highway board. That board has not, to my knowledge, positively refused to give their consent to this bill. I do not know whether they wish to petition against it. What we want is, that gas should be supplied by a company placed under proper parliamentary regulations. I do not think we can rely upon any promises that may be made by the old company as to their coming to Parliament for powers. I do not know that ever I was offered any of the shares of the old company.

Re-examined by Mr. THOMAS: It is my opinion that the town would not, under certain circumstances, have confidence in the old company. It is a private concern, and I have no means of knowing what their capital may be. I have never canvassed for shareholders in the old company.

Mr. *D. H. Morgan*, examined by Mr. RICHARDS.

I am the secretary of the Neath and Brecon Railway Company, and have lived at Neath nearly all my life. I still occasionally reside there. I have been mayor, and am still an alderman of the borough. Have been gas inspector for many years. The gas has not been satisfactory. Its illuminating power has not been good. At times I cannot see by it. Of the pressure I cannot speak, but I know that the cocks of the public lights have not been turned on sufficiently. The gas at the news-room was bad, and the smell when the door was shut was, at times, unbearable. The room was full of sulphurous exhalation, and was very oppressive to the chest.

Mr. HASSARD inquired if it had ever been tested for sulphur.

Mr. RICHARDS said it had been tested in every way.

Examination continued: It was mostly so. We thought it useless to complain. There was no remedy. We were dissatisfied with the manner in which the roads were disturbed by the company. They were ripped up and never properly replaced. I remember the rector once saying at a vestry meeting that the roads were all ridge and furrow.

The CHAIRMAN: I do not understand why the company were not indicted.

Mr. RICHARDS: Perhaps then it would have been worse, for the inhabitants might not have had any gas at all.

Cross-examined by Mr. BURKE: I was the partner for the last year. Was mostly in London. I did much in getting the corporation to sign the petition. There was but one dissentient amongst them. The solicitor went to the corporation with the petition ready cut and dried. The complaints in vestry were years ago. The company have no parliamentary power to break up the streets. The streets were under the control of the parish at the time when I was mayor. A man was fined many years ago for leaving an obstruction in the street.

Re-examined: The company might have refused to comply with any conditions that might be imposed upon them by the authorities of the town. They had the power to refuse to supply the town with gas. I never heard of the resolution in favour of the new company till I got to the corporation meeting. It was moved by Mr. Gardener, and seconded by myself.

Mr. *J. Phillips*, examined by Mr. THOMAS.

I am the superintendent of the police at Neath, and it is my duty to report to the gas inspector with reference to the public lights. The supply of gas has not been sufficient, particularly at one time, five years ago, when the company took the works from Messrs. Bonville. I have spoken to the manager several times about the lamps being out, and the inefficient supply. He told me that the consumption was more than the works could furnish. This is within the last two or three years. The supply of late has been deficient. The population has increased, and extra streets have been opened. The pressure has not been more than half of what it used to be. The illuminating power has been bad. The cocks of the public lamps have not been properly turned on. The lights are dim, and the dimness has extended over the whole town. I must say, however, that the gas within the last twelve months has been better than it was. The lamps have been turned out much earlier than they ought to be. The site of the old works is near to dwelling-houses. An open drain from the works goes near to these houses.

Mr. HASSARD: It may be a nuisance, but we cannot stop it up.

Re-examined: The refuse from the works is sent down the drain.

Cross-examined by Mr. BURKE: If it is a nuisance, it would be my duty to bring it under the notice of my employers. The property near the works is small cottage property. There is a marsh on the east of the works. The company have improved the works of late, and the supply of gas as well.

Re-examined: The quantity supplied to the public lamps is still deficient.

Mr. *Bartlett*, examined by Mr. RICHARDS.

I am a seedsman and market-gardener in Neath, and have resided there for 29 years. I am a member of the Town Council, and the owner of 36 houses. I have been a consumer of gas for several years, but have never been satisfied with it. When we have pretty good pressure we can see but middling. The pressure is taken off much earlier at times than I like. I have found difficulty frequently in lighting the gas. It has gone out before the paper with which I have attempted to light it. The public lamps have been badly supplied, and not at all like the lamps in other places. The public generally are not satisfied with the supply. I have known instances in which the company have refused to supply gas to the incoming tenant unless he paid a debt of the outgoing one. I know a case now of a Mr. Phillips. Windsor Street is becoming a very important one. It is not lighted at the present time, and there are frequent complaints of its not being so. I remember attending an auction sale at the Castle Hotel. The auctioneer could not read the conditions of sale on account of the gas. I have had put in my place a self-acting pressure register gauge, under the direction of Mr. Hughes, a gas engineer of London, and I have forwarded the register papers to that gentleman from time to time. The illuminating power of the gas has been tested by Mr. Hughes. It has been found to be but 8½ candles. I consider the site of the new works to be a good one. Thomas John Hutchings is the son of Mr. Hutchings, the butcher. The shares were taken by the father. The son signed the name himself. He is about 21 years of age. I think William Hutchings, jun., the chemist's assistant, is about the same age. They are all *bonâ fide* shareholders. There is a general feeling in the town as to taking shares. There is one gentleman now who is willing to taken up the whole of the remaining shares as soon as the bill is passed. The signatures are all *bonâ fide* ones. I have taken 483 myself, and there are a good many more besides. There are 700 or thereabouts. The rateable value of the petitioners property is about 11-15ths of that of the whole parish, which is estimated at about £15,144.

Cross-examined by Mr. BURKE: Cheap gas, of course, is the popular cry. I voted against the Public Health Act. I am a director of the new company. There was a circular sent round headed "For private circulation only." I have never been to the works to see if the company had a sufficient supply or not. I cannot say whether the fittings were perfect in the room at the Castle Hotel. The register apparatus put up in my house, under the direction of Mr. Hughes, was fixed by a gas-fitter named Evans. I never allowed the company to see the register. Mr. Hughes was employed when there was a case being got up against the company. I got the signatures of the young men Hutchings. I believe they paid the deposit of 5s. per share. The shares were £2 shares. I cannot say whether all those who have signed have paid their deposits. There is not a large number of names of persons on the share list who are unconnected with the town of Neath.

Re-examined by Mr. RICHARDS: There have been many names added to the petition since it was printed. There have been public meetings about the formation of the new company. It was well known that the company was being promoted, and the present company knew perfectly well what was going on. They sent their own servants to one of the meetings. The proceedings were fully reported in the newspapers.

Mr. BURKE: But the company's servants were turned out again.

Witness: They were requested to withdraw.

By Mr. HASSARD: Mr. Hughes did not put up the pressure-gauge himself. The premises in which it was fixed are a good deal higher than the works.

Mr. *G. J. May*, examined by Mr. THOMAS.

I am a chair manufacturer, of Neath. I took 169 of the signatures to the petition. Amongst that number there are only six who are not shareholders. I know the chemist's assistant; I do not exactly know his age, but he is an old-fashioned boy. He was persuaded by his father to take shares as an investment for his savings. He only got 4 per cent. at the bank, whereas it was said he would get 10 per cent. from the company. I am not a consumer of gas myself, believing it to be injurious in a household. There is a lamp opposite my house, which I consider is put out much too early.

Cross-examined by Mr. BURKE: The landlord of the Castle Hotel did not sign the petition, because, he said, a large portion of his business depended upon the custom of the gentlemen who were the members of the present company. We calculated the price of gas at first at 5s., but we were "green" then. We are more of a gold colour now. We do not expect to get a good deal out of 4s. 6d., but we think it will pay 15 per cent. The present company only supply about 75 houses. We only wish to compete with them fairly, and not to turn them out. The quality of the gas is the chief thing that is looked to—it is not so much the price. I think the old company are particularly blind to their own interests by not seeking parliamentary powers. The proposed company calculate upon purchasing coal from Mr. Vivian at 8s. per ton. There are many large houses in Neath which are not supplied with gas.

Mr. *Robert Smith*, examined by Mr. RICHARDS.

I am secretary to the South Wales Mineral Railway Company, and reside in Victoria Street, Westminster. I formerly lived in the Green Field Villas, in Neath. I took my family there in December, 1863. For 16 years previously I resided in Manchester, and whilst there I had some experience as a gas consumer. I took my fittings with me to Neath, and ordered gas to be laid on at my residence there. The gas was certainly not so good as I had expected it would have been. Of course I did not compare it with the Manchester gas, which was made mostly of cannel coal. It was very inferior in illuminating power—much inferior to what I had been accustomed to. It was superior in nothing except in price. I paid only 3s. 9d. in Manchester, but 5s. in Neath. I was obliged to put on more burners, and consequently consumed more gas. The gas was so impure that we could never sit in the room without the window being open. I was obliged at length to put a large ventilator in the room. I believe it arose from the sulphurous smell. I never made any payments to the officers of the company without complaining of these things. It cost me twice as much for gas in Neath as it did in Manchester. I have seen the public lights at Neath, and I do not think I was ever in a town where the gas was so bad, and yet Neath is in the neighbourhood of a coalfield—Glamorgan being one of the largest coalfields we have. I attended some of the meetings of the proposed company, with the intention of being a subscriber, till I found that I was likely to leave Neath, and then I discontinued my attendance. Every one had an opportunity of knowing when those meetings were to be held.

Cross-examined by Mr. BURKE: I brought my fittings from Manchester. The burners were used there, where we had gas from cannel coal. I had fresh burners in Neath. I had to use three burners in Neath as against two in Manchester. I believe that the illuminating power of the gas in Manchester is very great. I have heard it is more than 20-candle gas. I have heard that the standard in London is 14 candles. I cannot say what illuminating power the coal in the neighbourhood of Neath can give. I have always understood that it is very good coal. I do not know anything about the sulphur that may be contained in it. I cannot say whether I ever paid 5s. for gas in Manchester. My receipts show the price generally to have been 3s. 9d. That is since 1861. I do not know whether the price has been reduced there. I complained most assuredly to the manager of the Neath Gas-Works as to the quality of their gas. The person I complained mostly to was he who collected the accounts. I had something else to do than to be constantly complaining.

Re-examined by Mr. RICHARDS: I complained to the manager also. The nipples for the burners the company supplied themselves. They were new ones, and were put on by one of their men.

Mr. *James Kenway*, examined by Mr. THOMAS.

I live at Neath, and am a merchant and colliery proprietor. I have been mayor of Neath, and it is thirty years since I went to reside there. It was just before the present works were constructed. There have been baths established at Neath of late, and I am one of the directors of the bath company. There are Turkish and other baths. The practical management of them devolves upon me. We let the baths at first to a Mr. Bartholomew. He became bankrupt, and amongst other matters, he owed a bill for gas. The company took to the baths again on his bankruptcy. We use gas at the baths. We were applied to by the manager of the company to pay the debt of Bartholomew. We refused to pay because it was not right. The manager said that the law would compel the company to pay, and that if we did not pay they should cut the gas off. We objected to the utmost. Mr. Davis at last told me there was a minute on the books that the gas must be cut off if the debt was not paid. He said it was always the custom in such matters; he said that by law they could demand it. We had several interviews with him. Before we consented to pay, I got the directors of the baths together, and we discussed as to what was the best thing to be done. We found that

it was impossible for us to carry on the baths without the gas, so that we felt compelled to pay, and the directors agreed that it should be paid. We paid the debt, and then we got the gas. They had cut off the gas previously —I mean rather that there was a suspension of it to the baths. The supply of gas to the baths was very unsatisfactory. There were continual complaints about it. Sometimes it would go out just when a gentleman had got into a warm bath.

Mr. BURKE: And consequently he could not see to get out again.

Witness: There were continual complaints. Sometimes the gas would jump up and down. It was often a consideration with us whether we could not find some way of lighting the baths instead of with gas. I am also a private consumer of gas, and use it on my business premises. The gas supplied to me there is very bad indeed. It is very dim, and at times when I want it I cannot get it. I leave my office between six and seven o'clock. The gas goes out sometimes between five and six, just when I want to write my letters. I want the gas mostly from half-past four till half-past six. The pressure is oftentimes not enough to enable me to see at that time. I cannot at times get enough gas to see with. When I want gas the most it is of very little use to me. I was in the habit of burning candles frequently. I cannot say exactly whether there is more pressure between half-past six and seven o'clock. I very seldom use my gas after that time. We never had worse gas. I do not know whether the supply is efficient now. There used to be a very efficient supply. What I complain of now is the dimness, arising, as I suppose, from want of pressure. I used to frequent the reading-room, but I was driven out by the offensiveness of the gas some years ago. I am not prepared to state what the quality of the gas is which is used there now. I have not noticed any improvement in the gas within a short time. It certainly has not improved in brilliancy. I have not noticed that it has been better of late than it used to be. There has been within the last year or two a great agitation to put things right. The gas has been an intolerable nuisance. When I was mayor, in 1860, I think there was a public meeting held to see if we could not light the town ourselves. At the last meeting much and very general dissatisfaction was expressed. There has been general dissatisfaction expressed for some years. It would be impossible to have lived in the town without being aware of that general feeling. I can speak to the general feeling in the town in favour of the company being put under parliamentary restrictions. I think the petition speaks for itself on that point.

Cross-examined by Mr. BURKE: A company is desired under parliamentary restrictions. I do not know whether any one company under parliamentary restrictions would satisfy the town, or whether one company would be more virtuous than another. I suppose that the new company would be more virtuous than the old one. We want a company who would be under regulations and restrictions as to price, purity, and so on. It is years ago since I attended the reading-room. I do not know much about the pressure of the gas after six o'clock. Mr. Bartlett is a near neighbour of mine. I did not decline to serve with him in the Town Council. The reason I threw up my membership was owing to the election of a gentleman who was a shareholder of the old company, with whom I did not choose to sit at the same board. It was Mr. Philip Thomas. Mr. Bartlett is a most respectable man. I cannot say whether all the company's accounts for the supply of gas were sent in to the Turkish Bath Company, and not to Mr. Bartholomew. I never saw the accounts to my knowledge, and certainly never paid one. Mr. Bartholomew was the lessee of the baths, and not the manager. I cannot say whether the gas company ever recognized him. I had nothing to do with the bills. They had no right to demand payment from the company supposing that the bills were sent in to them. It was after Mr. Bartholomew had the lesseeship of the works that he failed. The manager of the gas company never said to me, jocosely, "All right, I shall look to your lessee." We have a colliery 20 miles off Neath. I am not a little angry because the gas company will not buy coals of me. I have got them to buy and burn my coals. I was not a little angry because they did not like them. I think I offered them coals at about 9s. per ton. I cannot say positively whether I was paid 10s. I rather think it was 9s. The solicitor to the bill is an intimate friend of mine. We are not working together. I have nothing to do with that. I cannot say whether I shall have to supply coal to the new company.

Re-examined by Mr. THOMAS: No suggestion has ever been made to me that the new company would take my coal.

Sir W. G. CRAIG: Were you a member of the corporation when this new company started?

Witness: No; I have not been a member since 1862.

Re-examination continued: I doubt whether it is more than a year since we could fix the improvement in the gas. There is a universal desire, as far as my experience goes, with reference to the starting of the new company. I should say that nine persons out of ten are anxious to see the company commence.

Mr. *Alexander Routledge*, the secretary of the Vale of Neath Railway, was next called, but

The COURT inquired what he was going to prove.

Mr. RICHARDS: Nothing, except that the railway were prepared, in case the bill were not allowed, to manufacture gas for themselves.

The COURT thought they had had sufficient evidence on that point already. There had been seven or eight witnesses called to show what the pressure of the gas was.

Mr. RICHARDS would call one witness, who was probably the largest consumer of gas in Neath.

The COURT: Why not have put him in at first?

Mr. RICHARDS: Because he came in the regular order. I will take him shortly.

The COURT: We do not require any more witnesses.

Mr. RICHARDS: Very well, sir. But I will call witnesses, subject to the approval of the court, with regard to the system which the company adopted with respect to incoming and outgoing tenants.

Mr. BURKE: I will admit it if you like.

Mr. RICHARDS: Very good; then I will call witnesses to show the system which has existed as to the employment of the company's own gas-fitters, and to the charges which have been made, if those persons were not employed. There have been large charges made for the connexion.

Mr. *William Evans*, examined by Mr. RICHARDS.

I am a gas-fitter, residing in Neath. I remember being employed in 1863 by Mr. W. Davis, of Queen Street, to fit up his house with gas-fittings. My work was done to the satisfaction of Mr. Davis, the manager of the gas partnership. I saw Mr. Davis, my employer, afterwards with reference to having the gas laid on. He did not say anything about the gas company. I had a conversation with Mr. Davis as to Mr. William Davis's supply. I had no order about it. I asked Mr. Davis, the gas manager, if I were to put up the fittings in a public house at Neath. His answer was, that he would have nothing to do with me. I do not remember that I said anything with reference to Mr. William Davis's supply. I went to the manager in consequence of something which Mr. William Davis told me. Soon afterwards I had the gas put on in my own house in the London Road. Mr. Davis had it put on. I applied to the manager of the company about it. He said that if I supplied my own fittings he would send his own fitter, and would charge me from the main in the road, which was 44 feet, I think. If I had not employed his man he would have charged me from the main to the house. In consequence of this I employed the company's men. I should have employed my own fitters but for that circumstance. I am a gas-fitter myself, and have two men in my employ, and I could have done it much cheaper than any one else. I fitted up the railway station and offices. I did not see Mr. Davis, the manager, about that. I think it was the railway company's own men that made the connexion between the main and the station. I had the order for fitting up the house and shop of another gentleman in the London Road, but the gas company's men did it. This was after a conversation I had with Mr. Davis, the manager. Of course, after he had chosen to fit up my own house it was enough for me. I had the order to fit up another house on the Parade, but the company's men put the gas in there also, although I am, as I have said, a gas-fitter, and could have done it myself. I did not ask Mr. Davis again, but acted upon his first answer. I have found, as a gas-fitter, that the company's acting in this way has prejudicially affected my business. There is a church in the course of erection at Neath. It has been fitted with gas-pipes by the company's men. I believe that I, as a gas-fitter, have given satisfaction to my customers.

Cross-examined by Mr. BURKE: Of course, the better the fittings were the better it was for the consumer and the supply. I believe the company employ good and able workmen. The company had a right to charge for fittings and for service-pipes. If a customer wanted to have gas laid on, the service would involve an outlay for which the company had a right to charge.

Mr. RICHARDS: There are other gas-fitters who are in the same position as yourself?

Witness: Yes, sir.

Mr. HASSARD: You speak as to the internal fittings of a house.

Witness: Yes. The gas company supply one or two lights from the meter, and then I go on with it.

Mr. HASSARD: You do not propose to interfere with the connexion?

Witness: Oh, no.

Mr. HASSARD: It is the internal fittings they require in the first instance to be laid up to by their fitters?

Witness: Yes, sir.

The CHAIRMAN announced, for the convenience of counsel, that at four o'clock he should have to leave the court to attend a deputation to the Home Office.

Mr. RICHARDS stated that the promoters had some evidence with reference to the existing works being a nuisance to the occupiers of houses immediately adjoining. It was true that the company might be indicted if they violated the law, but at the same time to tell a working man that he had a remedy at law was not much.

Mr. BURKE said the existing company did not admit any nuisance, except what was necessary.

Mr. HASSARD said it was impossible to make gas smell like violets. The promoters, no doubt, had some of their own officers and some other witnesses to show what they were really going to do.

Mr. RICHARDS said he would call the engineer of the company.

Mr. HASSARD said it would also be well to call Mr. Hughes in connexion with a former witness, because the evidence of that witness was of little or no use until it was connected with Mr. Hughes's.

Mr. BURKE: He never made a gas-works in his life.

Mr. *Jonathan Cass*, examined by Mr. THOMAS.

I am a lodging-house keeper in Neath. My house is on the same side of the street as the gas-works. There is only a footway of about six feet between us. I have lived in the house since 1859. There is a grating to take the water from the street into the sewer very near my door, and the gas company's pipes take the refuse from the works into it. I have the vapour and the effluvia from the drain in my house. I get the headache from it, and it takes away my appetite. The smell is very bad, and is constant more or less every day. It is very bad at times. It is also felt and complained of by my lodgers. It is a very great nuisance, not only to my house, but to all the neighbourhood. I should certainly not like to see the works extended.

Cross-examined by Mr. BURKE: My house is a lodging-house, not exactly for tramps, but for any person who comes there. There are never any rags or bones burnt in the house. The rent of the house is 12*s.* per month. I have had people leave the house on account of the smell of the gas. I do not remove because I cannot get a house to answer my purpose very well. I have got a stable there and a donkey.

Mr. BURKE: Does the donkey have the headache.

Witness: I cannot answer for that. I have complained about the drain to Mr. Davis, the inspector of nuisances.

Mr. HASSARD: What is the use of following this out? Admitted there are foul smells, this bill will not drive them away, except by persecuting the company out of place.

Witness: Mr. Davis referred me to Mr. Davis, the foreman of the gas-works, but he did nothing for me.

Mr. RICHARDS: I have the surveyor to the district Board of Health who will speak to the same thing.

Mr. HASSARD: Of what use will it be? If you get this bill it will not mend matters a bit, for the present company may remain as they are.

Mr. RICHARDS: I only put it forth as a misfeasance on the part of the present company, situated as they are in a dense part of the town.

Mr. BURKE: The promoters are quite willing to be put under legislation.

Mr. RICHARDS: If this bill does not pass, and these works are to be extended, it certainly does seem to me to be material to show there is an intolerable nuisance now.

Sir W. G. CRAIG: We know all that.

Mr. *John Thomas Brown Porter*, examined by Mr. RICHARDS.

My London office is at No. 7, John Street, Adelphi, and I also carry on business at Lincoln. I am a gas engineer of considerable experience, and have been concerned in the erection of gas-works in England and on the Continent. I was consulted on May, 1865, by the Neath new gas company, as to the establishment of works and the supply of gas to the town of Neath. I have since frequently visited the place with reference to the erection of new works, and am well acquainted with the neighbourhood. I have furnished an estimate for what, in my judgment, would be the necessary outlay for establishing works sufficient for the supply of Neath. I estimate the works and the buildings at £4000; mains, £3000; services, £1000; land, about £600; preliminary expenses, engineers, and contingencies, £1400; making altogether £10,000. These works will be quite ample for furnishing 20 million cubic feet per year, a quantity quite sufficient to supply from 10,000 to 15,000 persons, and quite adequate for the supply of Neath for some years to come, allowing for a considerable increase in the population. I calculate upon using about 250,000 tons of coal to produce 180,000 cubic feet. I believe

the coal the company would get would produce more. I have taken that as a minimum, and I have calculated the probable cost of coal per ton at 8s. 6d. From inquiries made on the spot, I believe that for 8s. 6d. the company will get a good gas coal, suitable for the purpose, such as will produce 8000 cubic feet per ton, of 14-candle gas. In fact, I have a letter offering the coal at 8s. or 8s. 6d., I forget which. I have also allowed for purification, salaries, labour, rates and taxes, wear and tear, repairs and contingencies, making a total of £1350 per annum. I have calculated that 18 million feet are manufactured in the holder. I take off 12 per cent. for distribution, and leave for sale 15,720,000, which, at 3s. 9d. per 1000 feet, will produce £2953 2s. 6d. I have reckoned from the sale of coke £550, allowing a certain quantity to be used for heating purposes. The ammoniacal liquor I put at £150, making the annual income £3650, the expenditure to produce which I estimate at £2300.

Mr. HASSARD: After all, it is nothing to us what dividend the company will make. What we want to ascertain is, what is the cost of production, giving credit for the residual products?

Witness: If you take the gas coal at 8s. 6d. per ton the cost will be as near as possible 2s. 6d. per 1000 feet.

Mr. HASSARD: 14-candle gas?

Witness: 14-candle gas. I may say here that in addition to this it will probably require a small amount of cannel coal to be mixed with the coal to produced the required standard, but that will not make a difference of more than ½d. to 2d. per 1000.

Mr. HASSARD: Have you taken that into account in the 2s. 6d.?

Witness: Yes; also depreciation and wear and tear; everything in short but dividend.

Mr. RICHARDS: Are there any chemical-works on the site of the present works?

Witness: On the other side. I have never perceived any annoyance arising from the chemical-works. I have made my calculations upon observation of places similarly situated to Neath. I have observed the public lamps, and when I was at Neath I noticed they were not burning the quantity of gas paid for, and that the light was exceedingly feeble. I have made some observations with a photometer at Mr. Bartlett's house, and I find the illuminating power of gas was 8½ candles. I made those observations three times, and it cleared 8½. The minimum was 7½. I saw the pressure-gauge at work at Mr. Bartlett's house. I had no reason to think that it was not working perfectly. I read it, and ascertained that the pressure was from 5 to 15/10ths of an inch—5/10ths during the day and 15/10ths at night.

Cross-examined by Mr. BURKE: The pressure-gauge is a very delicate instrument, but I have not known them to be out of order. I examined the instrument at Mr. Bartlett's house in the same manner as I would examine any instrument. I was going to work. I only examined it by my eye. Photometrical observations are very nice observations. I believe the photometer I used was made by Mr. Wright. It was provided by Mr. Hughes, and sent down to Mr. Bartlett's. Nobody had the opportunity while I was there of testing the accuracy of this instrument on behalf of the company. I propose to get the coal for the new works from Margain colliery. I have not learned the coal used by the present company, and I do not know anything about the amount of illuminating power it is capable of producing. I am a contractor for works, but I have not had the slightest intimation to contract for these works. I have taken shares in the proposed company, but I am not aware that I am the biggest shareholder on the list. I do not know why I took shares, but it was not at all in connexion with any contract. I am not connected with the town. I was called in on behalf of the company; I think by the secretary in the first instance, by Mr. May, who was, I suppose, the secretary *pro tem.* He did not ask me to take shares, but I took them voluntarily as an investment. I think it a very hopeful speculation for any company to supply a town of that magnitude. I cannot say whether it is a hopeful speculation for two companies to supply a town of 9000 inhabitants; but from what I know of the country, I think it must be a very hopeful speculation, not to annihilate the old company, but to come into competition with them, and I think the new company would get the best of the business. I cannot say whether the old company would give in at once, but I think it an exceedingly good speculation.

Re-examined by Mr. RICHARDS: The pressure-gauge is an instrument simple enough—about as complicated as a bottle-jack or a kitchen-clock. I do not know the price of coal at Plymouth. I believe they take Newcastle there. The price of gas there is 2s. 9d., I think.

Mr. HASSARD: We all know that the price of gas at one place is no criterion for the price at another. Did you design any of the works for those gentlemen?

Witness: No.

Mr. HASSARD: Are we to have any person who tested the gas at the works? The reason I ask is, that on looking through the bill I find there is, of course, a provision for testing the gas. Probably you are aware that there is a dispute as to where that testing is to take place. I thought the bill specifies the works. However, we have had a very heavy bill before us in this session, and the evidence given upon it is that the works are not the place where the gas ought to be tested. Then, again, your bill does not specify any pressure.

Mr. RICHARDS: No, sir; but, with very great deference, I cannot conceive it is desirable to specify any pressure.

Mr. HASSARD: There was the minimum pressure specified in the Brighton and Hove case, which was the one I allude to. The evidence then was, that at the works the pressure was 4 inches, and that the minimum pressure any where was 7/10ths of an inch.

Mr. RICHARDS: That is the pressure at the works when the pressure is put on at night.

Mr. HASSARD: It will depend on the distance. At two miles from there it would, of course, be in an inverse ratio to the distance, and also the elevations.

Mr. RICHARDS: I will not argue the point, but I should say that no pressure should be fixed, on account of the varying levels, and so on.

Mr. HASSARD: That is the reason why there should be a minimum.

(A short adjournment here took place, in consequence of the chairman having to attend the deputation alluded to.)

Samuel Hughes, Esq., examined by Mr. RICHARDS.

I am a civil engineer, residing in London, and amongst other things I have been a good deal engaged in gas-works there, gas accounts, and matters of that sort, for the last 15 or 16 years; also in making estimates and designs for gas-works, and in considering generally the cost of the production of gas; and I may say before that I was constantly engaged in making estimates and designs for large works, such as canal-bridges and things of that nature. I have examined the proposed site of the gas-works at Neath, and as a gas engineer I consider them exceedingly well adapted for supplying that town with gas. The site is a low one, and has the advantage of getting the coals by water carriage. It is some distance from any houses. I have considered what ought to be the productive power of works established at Neath, and I think the supply would very soon justify the establishment of works capable of supplying 14 or 16 million feet a year. I think there is no doubt the demand would increase rather more rapidly than in an average ratio. Gas-works generally doubled themselves in ten years. Some have doubled themselves in eight years. I take it that the increase in the supply in Neath would quite correspond with the largest increase in consumption. I take the estimate of the last witness to be a particularly proper estimate for the carrying on of works for the manufacture of 18 million feet per year. The actual supply would be something less; of course there would be the leakage to deduct. The maximum nightly supply in the winter time would be about 90,000 feet, or a 200th part of the whole. I have examined the illuminating power of the gas at present supplied in Neath by one of Wright's photometers, fitted up with all the most approved appliances. I have here notes of four distinct experiments that I made, each experiment comprising ten readings of the illuminating power on the photometer bar. They vary from 7·55 to 10·46 candles. I made these experiments on the 31st of January and the 1st of February. On the 31st of January the experiments averaged from 10·46 to 7·55. On the 1st of February I also took experiments, the result being 7·91 and 8·27. The testing was taken in the ordinary way, with a 15-hole Argand burner and a 7-inch chimney. I think this illuminating power to be excessively below what it ought to be, because I am aware of no recent gas Act in which less than 12 candles is fixed as the standard, and now the prevailing legislation is 14 candles for common gas and 18 candles for cannel gas. The price of the gas at present supplied at the Neath works is extremely expensive. In fact, 5s. per 1000 feet for 9-candle gas, which is higher than the average, is something like 7d. per 1000 feet per candle, which is monstrously high; whereas 12-candle gas at 4s. per 1000 feet would only be 4d. per candle, as we have it in London. So that the Neath is nearly double the London price, and nearly three and a half that of the Lancashire price, because what a man takes is really the light—he only really buys the light—he only buys the gas for the purpose of giving him the light; therefore, comparing the light with the price of the gas, it is nearly twice as expensive as London gas at 4s., and nearly three and a half times as expensive as Lancashire gas at about 3s. 4d. or 3s. 6d. I tested the gas for sulphuretted hydrogen. I used no test for an absolute quantity of sulphur, because that would require an experiment extending over some time, and the burning of the gas, but I tried with the test-paper; and I found it was tolerably free from sulphuretted hydrogen, highly charged with ammonia; indeed, the test-paper was immediately discoloured and made perfectly blood-red by the gas. I had a pressure-gauge put up at Neath, at the house of a Mr. Bartlett. I was told when I was at Neath that the gas was very much complained of on account of the deficient pressure, and in order to satisfy myself on that point I sent down a pressure-gauge, with a view of recording, properly and photometrically, what the pressure really was. It is a self-acting instrument, and the observations made by it are more valuable than any single observations or any number of single observations made with the pressure-gauge by a person, because it requires continuously a pressure of the gas. It is constantly marking the actual pressure at every instant throughout the twenty-four hours; therefore the results are exceedingly valuable.

Mr. HASSARD: There is a sort of wave line.

Witness: It is a wavy line, but in this case it was a tolerably uniform circle until about sunset, and then the pressure suddenly rose. Mr. Bartlett from time to time forwarded to me the results taken by this instrument. I examined them, and now produce them. In February in the present year the average pressure in the daytime scarcely ever exceeded 5/10ths or half an inch. I found that extremely low pressure generally commenced about eight or nine o'clock in the morning, and continued, during the first part of February, till about half-past four in the afternoon. During the hours when the meter consumption was going on the pressure was a good deal more than an inch, sometimes an inch and a half. But the great complaint I have to make is that the pressure was so low during the daytime. It was so low that it would be utterly impossible to use the gas for heating or cooking purposes, except at an enormous expense. It is a well ascertained fact that an ordinary lighting flame of gas is not the heating flame. You require an entirely different flame for heating purposes. You require the flame to be mixed with a considerable portion of atmospheric air, but no gas of that exceedingly low pressure that is supplied to Neath in the daytime will mix with atmospheric air. It is a great inconvenience that the town must suffer from in the daytime. An inch or an inch and a half pressure at night may be found to be enough; but I imagine that even with such a pressure as that complaints must very often arise on the part of consumers. I took the whole pressure during the twenty-four hours, but what struck me as so remarkable was the exceedingly low pressure in the daytime.

Sir W. G. CRAIG: What was the highest pressure?

Witness: I have not got the tables prepared. The highest pressure I did not notice so much as the lowest. The highest pressure might occasionally be as much as two inches, but very rarely that height.

Sir W. G. CRAIG: At what distance from the works would that be?

Witness: Mr. Bartlett's house would be about 400 yards, and I should say at the height, at least, of 30 feet.

Mr. HASSARD: Twenty-five feet he mentioned himself.

Witness: The gas could have been scarcely burnt at all with such a low pressure as must have prevailed in some parts of the town. I only know the coalfields accessible to Neath from some previous acquaintance. I have tried the gas at Cardiff, but I have no actual personal experience of it.

Mr. RICHARDS: Have you estimated the coal at the same price as Mr. Bartlett—namely, 8s. 6d. per ton?

Witness: I have made an estimate, taking the coal even at 10s. per ton, because I assumed that a very small quantity of cannel, about 10 per cent., would be required to get the gas up 14 candles. It is an extremely liberal assumption, but nevertheless, upon that calculation I conclude that the price proposed in the bill is a highly remunerative one. I calculate that 3s. 6d. per 1000 feet will pay considerably more than 10 per cent. on the capital.

Cross-examined by Mr. BURKE: I was first employed upon this matter, I think, about the beginning of the year, by Messrs. Marriott, the parliamentary agents. I was not told to get up a case against the old company, but I was sent down to examine the gas at Neath, probably with a view to give evidence on this bill. When I examined the gas at Mr. Bartlett's, it had all passed through his meter and fittings. It was ordinary consumers gas that I examined. I take it that there are very few day consumers of gas at Neath at such a price as is there charged. I should be very sorry to consume it in the daytime at that price. There would probably be more than two consumers in the daytime. There ought to be more than that number.

Mr. HASSARD: If a gas company were to put on a high pressure for two consumers, would not waste be going on to a great extent?

Witness: But the gas company, supplying gas under a proper arrangement, ought to put on sufficient pressure, about an inch, in order that persons might use gas economically. I do not think the waste would be at all considerable; certainly not sufficient to be entitled a large amount at all.

Mr. BURKE: Is not the waste proportionate to the pressure?

Witness: Yes; but an inch pressure is not an excessive pressure to give in the daytime.

Mr. BURKE: Is not the waste in proportion to the pressure?

Witness: No, not in proportion. The greater the pressure the greater the waste, but it is not in proportion.

Mr. BURKE: Do you know that every gas company in London put on a lower pressure by day than by night?

Witness: Yes; but no gas company in London, as far as I have observed, give less than an inch in the daytime.

Mr. BURKE: Do you know they have large day consumers?

Witness: Yes, because they gave the gas at a proper pressure, so that consumers can burn it in the daytime, which makes a very material difference.

Mr. BURKE: But by reason of having a less consumption by day than by night they give a less pressure by day than by night.

Witness: They give a less pressure by day than by night, because an inch is sufficient pressure by day. An inch will do for cooking purposes; but half an inch is utterly inadequate.

Mr. BURKE: Have you ever conducted gas-works in your life?

Witness: No.

Mr. BURKE: Have you ever constructed gas-works in your life?

Witness: No. I have prepared designs lately, and I am putting up gas-works of my own for the very purpose of making gas.

Mr. RICHARDS: Whether you have erected gas-works or not, I believe you have had about as much experience in the conduct of gas-works as any one?

Witness: Yes.

Mr. BURKE: In giving evidence against gas companies?

Witness: I mean to say that in examining gas-works, their accounts and statistics, and every detail connected with gas-works, I do not yield in experience to any man in this kingdom.

Mr. RICHARDS: You have told us that half an inch is a sufficient pressure in the daytime for any purpose to which gas can be put.

Witness: It makes gas to a great extent absolutely worthless. The fittings which the gas passed through at Mr. Bartlett's were average fittings, and they could not spoil the gas in any way that I could conceive. I was merely employed as a gas engineer by the parliamentary agent. I went down to Neath and examined the gas, and found it very bad gas. I bestowed sufficient time to inform my mind upon the subject. I think I was at Neath fully three or four days.

Sir W. G. CRAIG: Do you know anything about the gas at Swansea? That must be made from the same kind of coal I should think?

Witness: I do not at Swansea. I know about the gas at Cardiff, which is in the same neighbourhood. I do not know whether that is made precisely from the same bed of coal, because the Glamorganshire coalfield is so large and contains a great number of gas coals.

Mr. HASSARD: Do you consider the inch is the minimum pressure that a company ought to give anywhere?

Witness: I do, and I have made a great number of experiments on the pressure which is necessary to obtain the proper heating flame for gas, and I find that under an inch I cannot get a flame.

Mr. HASSARD: But that which suffices for a heating flame will not suffice at all for the illuminating flame?

Witness: Quite so.

Mr. BURKE then said he had a few words to address to the committee on behalf of the opponents of the bill. Perhaps he might take a too sanguine view, but he might say that a weaker case than that which had been made out on behalf of the promoters it had never been his fate to hear, and he hoped, and did not despair of bringing the committee to the same conviction. Here they had the fact of a company established, he quite admitted, not under parliamentary sanction, but established as a mercantile company for many years past in the town of Neath, aided and supported by the public authorities, when they were not making money, and opposed by them now that they were in a prosperous condition. Those gentlemen who were seeking to establish a new company for their own benefit, as he should proceed to show, approached the committee with a statement, as a fair and justifiable thing, that the old company had not fulfilled their duty to the public, and they wanted a company placed, as they said, under parliamentary sanction. Now, he did not seek to deny the fact that it might be better for the public that a company should be placed under parliamentary restrictions than that it should not be so placed; and that he said was a very slight ground of complaint the parties had against the existing company; indeed it was the sole ground of complaint they had against the company. The committee must certainly conclude from the evidence before them that one company was sufficient for the supply of Neath; there could be no doubt about that; so that if that one company were placed under proper parliamentary regulations and restrictions, it could not be denied that it would serve all the purposes of the public in the town, and obviously far more economically than it could be served by two companies. Therefore they had to look for the justification of the bill. The justification of the bill was founded simply upon the statement that the existing company was not subjected to parliamentary restrictions; but the weight of that argument totally failed, because he should be prepared to prove to the committee, by the most respectable evidence, that the company were perfectly willing, and always had been, to place themselves under parliamentary restrictions, but they had never been called upon to do so. The new company had thought proper to try and start themselves on their own account, and to see afterwards what bargain they could make with the old company, but they had never thought for a moment of coming to the company and asking them to be good enough to go to Parliament and place themselves under parliamentary restrictions themselves. So far from that, they had allowed the company to go on and to supply gas, as they said, unsatisfactorily to the public. They had never asked the company to adopt that course, but had eventually started their new company, covertly, as he said, with a prospectus sent round for private circulation, preventing the company from having a knowledge even of the adverse proceedings that were being taken against them as far as they could, and going to Parliament as though they were the only parties who were willing to place themselves under parliamentary restrictions. Now nothing more unfair to the existing company could hardly be conceived. On what grounds was their case founded? He would recall the attention of the committee to the evidence they had heard. Of course he was quite willing to admit this, that the Neath Gas Company no more than any other company in the world had been free from complaints from time to time. A new house had its fittings out of order, and the gas did not pass in sufficient quantity through them, and the proprietor had at once complained to the gas company about it. Those complaints, however, seemed to extend over a period of years, and some of them were as far as fifteen years past. They admitted the fact that some years ago their works were let to a lessee, who did not fulfil his obligations to the public; but what did they do? It was admitted by the evidence on the part of the promoters that in 1861, finding that to be the case, they stepped in and ousted the lessee, which they did at very considerable expense to themselves, paying him a large sum of money to retire, and taking the works into their own hands; and by the admission of these witnesses, after that period the supply of gas had improved. Two or three witnesses had told the committee that for the last year or so they had no complaints to make, and therefore it was quite clear the new company had based their grievances upon a state of things which, it was admitted, existed years ago, and which the old company had done their best to cure. The committee had had one witness after another to tell them so. In all such cases, and he had had to deal with dozens of them, as had also his learned friend, witnesses came and told the committee that the gas was impure, and gave an insufficient illuminating power. But then came the question, what means had they taken to test it; and he would ask the committee to say whether they thought the system of testing in this case was fair, whether they thought it right for a gentleman to be employed to get up a case against the company? That was to say, employed by the opponents of the company, knowing he was employed, and going to the house of an adverse party, establishing a photometer—a self-acting register—there, and testing the gas after it had passed through the fittings in use at the time. Those fittings might have been as foul as possible to obstruct the pressure for what they knew. They gave no opportunity for the representatives of the company to be present at those testings, but they get up a case of their own. Was that evidence to be considered as satisfactory to the committee? Were the tests anything like fair ones? No one knew better than his learned friend that, in an inquiry in another room, parties had sought to establish tests in the absence of gas companies, and that in the year 1860, in the Metropolis Gas Act, an effort was made to establish gas tests, for gas to be under the control of local vestries. His clients said that the manner in which the gas had been tested was unfair, and he (the learned counsel) contended that no test conducted by adverse parties could be sufficient to satisfy the committee, or to justify the infliction of a penalty for a non-observance of the Act. Other parties, he submitted, must be present at the testings, and it must be seen whether they were conducted with fairness. Such a provision was inserted in the Gas Act, and it was in consequence of an opposition that had been made that a clause had been placed in the Metropolis Gas Act to the effect that no test should be considered sufficient in order to inflict a penalty unless the company had had six hours notice of the intention of parties to make an examination, the parties themselves being present at the time. If that was fair over the whole City of London, why not for Neath? But that would not suit the parties, because the committee would see they preferred giving the old company no notice, but doing all in secret; getting down Mr. Hughes, a gentleman—he did not say it to his discredit—but a gentleman whose avocation and sole profession was to get up cases against gas companies. He (the learned counsel) had examined him in twenty cases himself, and he ventured to say that he was hardly ever called in support of gas companies, but against them. As far as testing went, therefore, his evidence was absolutely nothing, as he (the learned counsel) should be in a position to prove not only the quality of the gas, but the efforts that had been made from time to time to ensure its purity, the efficient supply and state of their works, and the adequacy of those works to supply gas in the most efficient manner. He could show that the company were in a condition to supply plenty of gas at that moment, and there seemed to be no charge against them that they were not, although an effort seemed to have been made to show that they had not supplied certain streets; but the committee knew how that ended in cross-examination. After the company were asked to supply a particular street, and had been put to the expense of buying pipes and laying them on the ground, the local board refused to permit them to lay them in it under a certain penalty, or else they required the company to maintain the streets for a year. The learned counsel could assure the committee that they had got their pipes throughout the whole of Neath, and if the new company were to be established, way their pipes would have to be laid in juxtaposition with the old company's everywhere. There was no evidence to the contrary, and if there were he should be in a condition to rebut it. There was nothing to show that the company were not in a condition to supply any amount of gas to Neath that it could require. If that was the case—if the company were willing to place themselves under parliamentary regulations and restrictions—what possible justification could there be for the establishment of a new company. There were petitions, it was true, in favour of the establishment of the new company; but what, he would ask, could be easier than to get up petitions of that kind? Parties went round, and said, "Sign a petition for cheap gas." He asked the witnesses whether that was the cry used, and they did not deny it. The inhabitants did not care if it was for the establishment of a new company or for the coercion of the existing one—they would sign fast enough for cheap gas. And who were the parties who did it? They had, of course, the solicitor, who came with his petition cut and dried to the corporation, in favour of the bill. Then they had the chairman of the company, and his late partner, who came for two days down to Neath, but who lived in London, and who seconded the adoption of the petition, no notice having been given of it as required by the Municipal Act. These were parties professionally interested. Next they brought Mr. Porter to give evidence in favour of the bill; but who was Mr. Porter? A contractor for gas-works. Did he expect to have a gas contract? Of course not, was his answer. Did he subscribe? No. The committee must judge of that themselves. Did the gentleman go to Neath, and put his name down as a subscriber to gas-works there, and expect to get nothing out of it? There was no doubt that Mr. Porter hoped to make money as a contractor, and he (the learned counsel) did not quarrel with him for doing so; but he was a gentleman who, no doubt, consulted his own interest, and said that if he got a good job he was justified in doing it. But that was no justification for the bill. The whole manner in which the scheme had been got up indicated that it was a mere private speculation for the benefit of certain individuals, and that it could not by possibility be for the benefit of the public, as he should proceed to show. Now, first of all, it was not denied by his learned friend in his opening address—he did not deny it because he could not—that it was an evil to the community to have the streets broken up for two sets of mains. Every honourable member who lived in a town would know what a constant recurring nuisance that was. One witness had been called to speak to the bad state of the streets, caused by the breaking up of one company; so that if the streets were injured by the breaking up of one company, *a fortiori* they would be more injured by the breaking up of two. Again, they all knew that escapes would arise from the gas-pipes. The joints got loosened by the passage of the traffic, the subsidence of the soil, and so on; and if two pipes were to be placed in juxtaposition, it would not be known from which pipe the escape emanated. The consequence would be, the streets would have to be broken up twice over. This had been done in many places, and what had been the consequence? Why, in the inquiry upon this subject in the case of the Metropolis Gas Bill, it had been very properly decided that there should be but one company to supply a locality. If one company could supply a locality under proper parliamentary restrictions, that was the proper thing to be done; consequently, it would be found

that such a provision had been inserted in the preamble of the Metropolis Gas Bill. Formerly there was competition in the streets of the metropolis; but the companies at last determined that competition was useless; they were ruining one another breaking up the streets and incurring constant complaints, so they determined they would no longer compete, but would divide London into districts. The case, therefore, came before Parliament, and in the preamble of the bill would be found a recognition of this fact. Then, in an adjoining room, they had been told by the committee that the proper thing appeared to be that one company should supply a district and not two. The reasonableness of this was obvious. It was not only by reason of the nuisance and annoyance in breaking up the streets, but from this also—that by the recent legislation under the Gas Clauses Act, which his clients were not subjected to then, but which they were willing to come under, provision was made that as soon as a company could divide 10 per cent. of their capital, they must reduce the price of their gas; and what had been the operation of that? Why, taking the City of London, taking every city in which the Gas Clauses Act was in operation, it would be found that there had been a gradual reduction in the price of gas. Then did it not stand to reason that, if they doubled the capital employed in the supply of gas, they protracted *pro tanto* the period at which that reduction could take place? If he, with an expenditure, of £10,000, was in a condition to supply all Neath, what he said, and it was not denied, was that, if they came under the Gas Clauses Consolidation Act, the moment they divided 10 per cent. on £10,000 they must reduce the charge to the public. It was obvious, therefore, that if another company was established the amount of capital would be increased to £20,000, and the result would be that £2000 must be taken out of the pockets of the public before the price could be reduced. Obviously, therefore, it could not be for the benefit of the public that another company should be established, unless the existing company were unwilling, which they were not, to place themselves under parliamentary control. Certain complaints had been made about incoming tenants being charged for outgoing ones. He admitted, as did also his learned friend, that it had been the case for almost all gas companies to act upon the same principle. They were certainly rather unfortunate in the case they brought forward, the case of the Turkish Bath Company. This company chose to introduce a man as their manager whom the gas company refused to recognize, and they invariably sent in their accounts to the bath company. But when the lessee or manager of the bath company became bankrupt or absconded, the gas company said to them, "You owe us so much money." "No, it is our manager." "We say," said the company, "you owe it to us, and unless you pay it we will not continue to supply you with gas;" and the bath company thought it right to pay the money. If there was any defect of that kind in the constitution of the company it might be regulated by Act of Parliament, and it would have been a reasonable and proper thing for the corporation, or for any one who was dissatisfied with them, to have come and said—"Gentlemen, you are not under an Act of Parliament, as you ought to be; unless you go to Parliament we must get up a new company." There would have been some reason in that, and they would have found a perfect readiness on the part of the company to meet their requirements and go to Parliament. But although the new company had obtained the sanction of the corporation, some of those who were in charge of the roads were against their scheme; they knew the injury that would arise from the breaking up of the streets, and the new company had failed to obtain their assent to their proposed scheme. They proposed, therefore, against the will of those gentlemen who had the control of the thoroughfares, to get an Act of Parliament to break up the streets just as they might think fit; otherwise they did not want an Act, for they might do as the existing company had done. In fact, they said they had constituted themselves as a company under the Limited Liability Act, but they came to Parliament for compulsory powers to enable them to break up the streets as they thought fit for the purpose of laying down their pipes, under the powers which the Gas Clauses Act would give them, against the will of the parties who had the control of the streets.

Mr. RICHARDS: They did not petition for the old company; they are neither on one side nor the other.

Mr. BURKE: They had expressed their dissent to the bill, and they would have petitioned, he was told, if they had been required to do so. The promoters had failed, however, to obtain their consent, therefore they proposed to get the power against their will. But, supposing they got the Act, he would ask the committee to look at the unfairness it would be to the existing company. The new company were calculating on a large return to be derived at the expense of the old. To suppose that they could obtain any profit in competing with the old company, from half the consumption of the town, was perfectly idle; but they assumed this, that if they got an Act of Parliament, and the old company had not one, they would have ther power of breaking up the streets, whereas the old company had not. The old company could only now break up by permission of the local authorities. So long as there was only one party the authorities would be good enough to give their permission, and they had done so for many years past, but the moment they got the new company, fostered and encouraged by Mr. Gardener as a member of the Town Council, the corporation, his colleagues, and all the rest, they would say the new company might break up the streets by authority, should they no longer give them power to do so. Was the whole of the outlay of the existing company, amounting, as their opponents said, to something like £10,000, to be sacrified by the bill? He would ask the committee whether there was any justification for this—putting themselves in the position of the gentlemen he represented, and highly respectable gentlemen they were—gentlemen who had the interests of the town of Neath at heart, who had for years past done their best to supply it with gas, who had laid out money to the extent of £10,000, and who were willing to put themselves under parliamentary restrictions, under any restrictions which the new company were willing to put themselves under, and yet the modest proposal was that the new company should be established with parliamentary power, the result of which would be the total confiscation of the property of the old company. They knew that, and the parliamentary agents had very wisely put in the bill "power to buy up the works of the old company, and for them to sell." Why, of course, they reduced the value of the old works to next to nothing by those powers. They would then try to buy up the old company for nothing, and get a monopoly in their own hands, without which they could not live. That must be obvious, and that it was clearly and distinctly for the benefit of a few gentlemen who hoped to make a profit out of the concern by professional avocations, contracts, and so forth; but he thought it must strike the committee distinctly that as far as the shareholders were concerned a more hopeless speculation had never been propounded. He should like to know where a town could be found in this kingdom, with 9000 inhabitants only, in which Parliament had sanctioned two competing gas companies. Why it was most ridiculous to think of having two companies competing with each other in a town of that magnitude. He knew that there were cases of much larger towns in which competition had been allowed. He had known it to be allowed in Reading and other places, but in no one case with which he was acquainted had the competition done anything than end in combination. That was the necessary consequence, and it was reasonable to suppose the old company could compete with another company on fair terms. The new company hoped the old would not be able to compete with them on fair terms; but, supposing they could, the old company were not going to allow themselves to be swamped at once. The old company could compete with them at low charges for a time, the same as railway companies did, who took passengers to Newmarket and back for 5s., but that could not go on for long. The competing companies would at last combine, and what would be the result? The public would have the two capitals to pay upon instead of one. That had been the result in every town. He did not suppose his learned friend could show him a single town in England where competition in gas was going on at this moment. He doubted the existence of one; he did not know of one himself, and he had no little experience with these things. He had known cases where Parliament had—he was going to say, been foolish enough, but that would be a disrespectful term to use—granted competition in towns, not upon evidence such as they had there, but upon very much stronger evidence, which had resulted in combination. But for a town of the size of Neath, with 9000 inhabitants only, where there was a company competent and willing to supply it with gas, to ask for a new company was perfectly idle and ridiculous. He said, therefore, he was entitled to ask the committee, upon the evidence as it stood, without calling a single witness before them, to reject the bill on the ground of the non-existence of necessity. Parliament, he was sure, would not grant its legislative powers to speculators merely for their own purposes, unless they could satisfy it there was urgent public necessity for parliamentary powers being granted. They must establish to the satisfaction of the committee that there was an urgent public necessity for passing a bill before they could ask the sanction of Parliament to it. He ventured to ask whether that urgent public necessity had been shown in this case? So far, it had been otherwise. There was the existing company in a position to supply gas, having its mains over the whole of the town; there was the admission, on the part of the promoters, that the gas had been fairly good, especially within the last year or two; there was an admission also on their part of a readiness to give any pledge that the promoters might require for their satisfaction that in the very next session of Parliament they would place themselves under every parliamentary restriction that the new company proposed to come under; and under such circumstances, he would again ask the committee where was the public exigency for this bill? Was there any public necessity for it? Was there any justification for it? Was he not right in stating that the passing of this bill infallible, whilst it would injure his clients to a great extent, would tend not to the benefit of the public, but directly to the contrary, by exposing them to all the annoyance of an unnecessary breaking up of streets, the unnecessary employment of two capitals, on which the public would have to pay a dividend, where one was sufficient for the purpose, and so on? So far, then, from public necessity being a justification for the bill, the arguments were all the other way; for the passing of the bill, whilst it would be injurious to the existing company, would be an absolute detriment to the public. He hoped he had, in the remarks he had made, stated sufficient to ask at the hands of the committee a rejection of the bill. He was in a condition to produce evidence before the committee as to the quality of the gas, the sufficiency of the power, the means of supply, and various other matters, in rebuttal of the evidence on the other side; but he said, moreover, on the evidence as it now stood, he was in a condition to ask the committee for a rejection of this bill. Unless they were satisfied upon the evidence that the passing of the bill would of itself be just to the existing company, and at the same time beneficial to the public, he trusted the committee would come to that conclusion without the necessity of hearing further evidence.

Mr. RICHARDS: Do you call any witnesses?

Mr. BURKE: If the committee require it. I will put it to the committee whether they require any.

The CHAIRMAN: The committee cannot decide themselves without hearing evidence.

The following witnesses were then called:—

Mr. *Peter David*, examined by Mr. MICHAEL.

I am a coal merchant, carrying on business at Neath, Carmarthen, Haverfordwest, and other places. I have been for many years in the habit of supplying the Neath Gas Company with coal. I have been familiar with the progress of the Neath Gas Company from its commencement. I remember the time when the works were leased to the Messrs. Bonville, and also the time when the company took the works in their own hands. When the Bonvilles had the works, the supply was very bad, and a great many complaints were made respecting it. Since that time and up to the present the gas has very much improved. The price charged at one time was 7s. per 1000 feet; now it is 5s. per 1000 feet. I charge for the coal 10s. 6d. and 11s. per ton, the one being of a higher illuminating power than the other. Coals of the quality that I supply cannot be obtained cheaper. I am well acquainted with the South Wales coal basin. This portion of it is upon what is called the steam coal portion of the basin, the Aberdare district, running down to Neath. That coal is not suitable for gas making, which requires the bituminous coal, free from sulphur and other impurities, which is not to be procured easily in the neighbourhood of Neath. I know Mr. Kenway's coal. It is not at all fit for gas making purposes. Mr. Vivian's is not a good gas coal, although it is a bituminous coal. There could be gas made out of it, but not equal to that with which we supply Neath. I remember, when the company took the works from the Messrs. Bonville, application being made to parties to take shares in the company. I myself endeavoured to induce the inhabitants to take them. I was originally a director, but as I supplied coal to the company I resigned my post. I believe only three persons took shares in the company, and one of them withdrew. I was requested at that time to procure a large amount of additional capital to extend the works. The shares were then very low in the estimation of the public, as the company were not paying a good dividend.

Mr. RICHARDS: What were they paying?

Witness: Seven and a half per cent.

Mr. MICHAEL: I am told to ask you whether it was not a fact that the works became so depreciated that in reality there was no dividend paid?

Witness: At one time there was not; it was during the time of the Messrs. Bonville. The Bonvilles were, under the lease, to give in a certain dividend; but providing we had not carried on the works, there would have been no dividend. The public lamps are adequately supplied with gas at the present time. I have myself had the gas on lately, within the last two months, and I have no cause to complain of it. There is not in reality any complaint on the part of the town of Neath, but only what we call an agitation, which has been got up under the cry of cheap gas. Of course, everybody would like an article cheap rather than dear.

Cross-examined by Mr. RICHARDS: It has been an agitation got up. I am a shareholder in the old company and a petitioner against the bill. Of course we should be likely to be affected if a new company were to come in. They might take some of Mr. Peter David's coal, and it would be an advan-

tage to them if they did. I have no reason to complain of my contract with the company. The price is not particularly high for good gas coal. That which I supply is far better than either Mr. Kenway's or Mr. Vivian's. It is the best coal in the neighbourhood.

Mr. RICHARDS: You first said that the company was paying no dividend at all, and afterwards that it was paying 7½ per cent. At what period was that?

Witness: At the time Mr. Bonville had the works.

Mr. RICHARDS: When they were in such a very bad state?

Witness: Yes; but I believe it was not 7½ per cent. all through his time.

Mr. RICHARDS: Do you know that 7½ per cent. is about the maximum dividend allowed in the present day to any gas company?

Witness: We have not received 6 per cent. altogether.

Mr. BURKE: No gas company is allowed less than 10 per cent. on their original capital.

Mr. RICHARDS: Do you know that the Gas Clauses Act limits the dividend to 10 per cent.?

Witness: I do not know anything about the clauses. Mr. Bonville paid rent for the works. I do not know whether it was £300 a year or not. I do not remember what it was. I do not know what was the capital at the time we were paying 6 per cent. I do not know anything at all about the capital. I only know that I was receiving at that rate on the amount of my shares. We are in the habit of getting 10 per cent. We have never had more than that, and that only for the last two years or two years and a half. I have never taken any interest respecting the capital.

Mr. RICHARDS: Your confidence in the concern does not extend to burning the gas. You have only taken to that for the last two months?

Witness: About two months, I believe.

Mr. RICHARDS: Do you know anything about what you sell your coke for?

Witness: I do not know; that is not my business at all.

Re-examined by Mr. BURKE: I believe under the lease Mr. Bonville was to pay 7½ per cent. for the latter end of the time, but, finding that he did not fulfil his contract to the satisfaction of the public, the company paid him a sum of money to give back the lease.

Mr. *Henry Bowen*, examined by Mr. BURKE.

I am the manager of the Cardiff Gas-Works, and have been so for the last 19 years. I am tolerably well acquainted with the manufacture and quality of gas. I have made three visits to the Neath Gas-Works, and made careful examinations of them. They are in a very good state. The works are very well constructed, and capable of supplying all the town of Neath.

Mr. HASSARD: Will you tell us what they are capable of supplying?

Witness: From 14 to 15 millions a year, I should think. I believe there is land adjoining on which the company could erect additional works if they saw fit to do so. I see no sort of difficulty in their keeping pace with the increase of the population. I do not see in the least any opening for a new company. I should think a new company would not pay in competition with the existing one. I have found the quality of gas supplied by the existing company from 12 to 13-candle illuminating power. I arrived at this result from photometrical experiments. I looked at the public lights, and found them in a very fair condition, burning about 4 feet per hour. I consider £3 5s. per annum for those lamps to be a low charge. It would be about 3s. 5d. per 1000 feet, whilst the private consumer is charged 5s. We have diminished the price at Cardiff from time to time, and, in fact, the general result of increased consumption is to diminish the price. No doubt if this company is left to itself, and the consumption of the town increased, the price will also be diminished. I have had some experience myself in gas agitation, which is an endeavour to screw companies down to the lowest price by threatening new companies. I do not know anything about the coal in the neighbourhood of Neath.

Cross-examined by Mr. RICHARDS: We have a capital ourselves. I went to Neath as an engineer, knowing I was coming before Parliament as a witness. The maximum price of gas in the borough of Cardiff is 3s. 3d.; in the outlying district 3s. 9d. We get South Wales coal from the Rhondda Valley, about 12 miles from Cardiff. I suppose it would be about 25 miles from Neath. I was asked on one occasion to examine the gas by the solicitor of the company, and on one occasion I wrote to tell him when I should make the examination, and when I might be expected to examine it. I gave the company notice I was coming on one occasion, but on the last occasion they did not know anything about it. It is not a very difficult thing to improve the quality of gas, if a little notice of the examination is given beforehand, supposing you have the material to do it with. I judged of the quantity the public lights were burning merely by my own eyes. We pay at Cardiff 8s. 9d. for common coal, from which we get an illuminating power of from 11 to 12-candle gas; but as we give from 12 to 13-candle gas, we have to use a proportionate quantity of cannel coal, for which we pay now from 24s. to 25s. The quantity of cannel coal, of course, varies according to the quality of the common coal.

Re-examined by Mr. BURKE: I suppose the population of Cardiff is nearly 40,000, but we light a large district adjoining. The price of gas before the reduction has been 3s. 6d. and 3s. 10d., and notwithstanding we have a monopoly we have kept decreasing the price in proportion to the increased quantities supplied. If we had a competing company we could not sell it so cheaply, or if we had we could not pay any dividend. We are limited to 8 per cent. on our new capital and 10 per cent. on the old. Two-thirds of the capital is at 8 per cent. and one-third at 10 per cent. We have paid our dividends, and consequently reduced the price to the public; but supposing there was a double capital, we could not make the dividend, and the public therefore would not have the reduction. We supply over 100 million feet of gas per annum. I think the public lamps of the town of Neath are particularly good for the price, and the works of the company cannot be much better situated than they are.

Mr. *Thornton Andrews*, examined by Mr. MICHAEL.

I have been manager of the Swansea Gas-Works for the last ten years, and am perfectly acquainted with the district. I am acquainted with the town of Neath, and yesterday I received a telegram to test the gas and to inspect the works of the Neath Gas Company. The foreman of the yard at first refused to admit me without producing an order, and I then produced the telegram I had received, and was admitted. I found the retorts in very good condition, the works generally in good order, and the whole of the apparatus apparently new, as if they had been lately erected. The works I consider to be most favourably situated in the lower part of the town, with respect to the level. I took with me Sugg's apparatus, combined with the latest improvements, and set it up in the works in order to test the gas photometrically. The result of thirty observations in two experiments yielded an average of 12·36 sperm candles. I commenced at six o'clock, when the pressure was 18/10ths of an inch in the town. It was then daylight. I went afterwards to some of the principal consumers, in order to test the gas at their places of business. I have the testing papers with which I tested the gas. I went to the shop of Mr. Curtis, in Wine Street, who is a silversmith, and I tested the gas from the gaselier in the shop, and found it perfectly free from sulphuretted hydrogen and ammonia. I had no opportunity of testing it for free sulphur. I took three burners from the public lamps. The quantity of gas burnt would of course depend upon the pressure, but I should say, taking the ordinary working pressure, they would yield from 7 to 8 feet per hour, with the cocks fully turned on, and about 5 feet per hour if half turned on. There is in the neighbourhood of Neath a gas coal of a very low standard of bituminous quality—several veins of it. Swansea is supplied from the Llanwit in the valley. We pay 10s. for it at Swansea. I know Mr. Vivian's Margain pit. We could not use his coal with advantage for gas purposes, or we should do so. As we have to go a considerable distance, and as there is not coal in the district from which we can obtain 14-candle gas, we have to mix cannel with what we use, to obtain the proper illuminating power. We are under the Swansea Gas Act of 1861 and the Acts incorporated with it. We have a monopoly, but we have, notwithstanding, reduced the price of gas from 5s. to 4s. The price to the public lamps is 3s. 10d. per 1000 feet; £3 5s. each per annum, less 15s. for cleaning, lighting, and extinguishing. I calculate the charge upon the basis of 4 feet per hour, burning 10 hours per night, 3350 hours per annum, 30 days, I believe, being excluded.

Cross-examined by Mr. RICHARDS: I have been at the Neath Gas-Works before, but not often. I formerly visited Neath. When I visited the works a telegram arrived to say I was coming, but not till two hours after my arrival. The paper I produce is turmeric paper. I moistened it.

Re-examined by Mr. BURKE: We take a very large quantity of coal. The price of gas at Swansea is 4s. per 1000 feet to private consumers. We pay our maximum dividend of 10 per cent. We intend as soon as possible to reduce the price still further. I consider the Neath company to be quite in a position to supply the town.

Thomas G. Barlow, Esq., examined by Mr. BURKE.

I have had considerable experience in gas-making and erecting gas-works. I have been down to examine the Neath Gas-Works. The works themselves are, with the exception of one of the gasholders, I may say, new within the last three years. There are 20 retorts; 15 of them only were in operation during the last winter, therefore there are five surplus ones. There is room for the erection of two more beds of 10 retorts. The condensing and purifying apparatus are entirely new. They are of very ample capacity, and one of the gasholders is entirely new; in fact, my opinion is, that they are very excellent works indeed. By the addition of 10 more retorts and another gasholder they could make double the quantity of gas they made during the last winter.

Mr. BURKE: Then you can see no sort of fear of these works not being able to continue to supply the population of Neath, even if it goes on increasing as it has done during the last year?

Witness: Certainly not, for many years to come. The works are well situated. They are on the lowest level, on the banks of a canal, almost in the centre of the district, as it were, and on the side of the town where, according to the prevalent winds, any effluvia from them is blown away. I can see no justification for the establishment of a rival company. I conceive that the present company are supplying gas of the best quality that can be made from the coal of the district, and at a very moderate price. I believe the result of establishing another company would be to lower the price for a few years, and end in combination between the two parties, and payment on a double capital.

Mr. HASSARD: The witness speaks of a low price. Does he allude to 5s. as a low price?

Mr. BURKE: Is 5s. in your judgment a fair price now?

Witness: It is, looking at the consumption. It is now under 10 million feet a year.

Mr. BURKE: Have you any doubt that with increased consumption the company would gradually reduce their charges?

Witness: It seems probable they would do so. That has been the universal result with companies under the Gas-Works Clauses Act. I tested the illuminating power of the gas at Neath, and its purity. The illuminating power was equivalent to 12½ candles. I did examine the coals supplied chemically. The area of the supply of bituminous coal in the neighbourhood is rather limited. It is a steam coal district. The public lights were burning from 4 to 4½ feet hour, from nine to eleven o'clock. I considered them fair lights. I constructed the Cardiff Gas-Works about the year 1836 or 1837.

Mr. BURKE: Having constructed the Cardiff Gas-Works, and comparing those of Neath with them, do you consider the Neath Gas-Works to have been well considered before they were constructed, and particularly adequate for the purpose for which they were constructed?

Witness: There is very little of the original works remaining. The works have been so entirely reconstructed and rearranged that they may be called modern works, and almost model ones. They are made according to all modern improvements. The price charged for the lamps I consider to be very moderate. After deducting the lighting, cleansing, repairing, and interest on the capital expended in the posts and columns, the price charged only leaves about 3s. 6d. per 1000 feet for the gas.

Mr. BURKE: I dare say you have seen in your experience more than one instance of these companies trying to get up an agitation?

Witness: I have seen scores of them.

Mr. BURKE: They leave the companies alone while they are making little dividends; but when those companies become prosperous they get up a competition with them, and endeavour to buy them?

Witness: Just so.

Cross-examined by Mr. RICHARDS: These have been cases where there has been an established company, and not a speculative partnership?

Witness: There have been many instances of competition between partnerships, and they have ended in amalgamation.

Mr. RICHARDS: A great deal has been said about Mr. Hughes appearing against gas companies. I think Mr. Thomas Greaves Barlow appears about as often for companies?

Witness: Very often.

Mr. BURKE: There is this difference—Mr. Barlow has constructed dozens of works, and Mr. Hughes never constructed one in his life.

Mr. RICHARDS: Do you think 5s. a fair price for gas at Neath?

Witness: I think it is, taking into account the present consumption. I cannot call to mind at the present moment any place situated so near the coalfields paying so much as 5s. per 1000 feet for 12-candle gas. Leamington and Dover are not so near the coalfields, but the consumption is very large in those places. The consumption of Canterbury must be five times that of Neath.

Re-examined by Mr. BURKE: Swansea is close to the coalfield. In Cardiff the consumption is very large. I think that when I erected the works at Cardiff the charge was about 7s. It has been gradually reduced, and if this company were left alone now, they would reduce their price too.

Sir W. G. CRAIG: Is not 10 million feet of gas a very small consumption for a town of 9000 inhabitants?

Witness: No, it is not. The usual calculation is from 1000 to 1200 feet per head. Cardiff is very different indeed to Neath. The consumption in Cardiff, with 40,000 inhabitants, is 100 million feet; but Cardiff is a very different place to Neath.

Sir W. G. CRAIG: Can you account for that difference in the consumption?

Witness: They are a very different class of towns. Cardiff is a bustling, commercial, important town, with a large number of traders, whereas a large proportion of the inhabitants of Neath are workpeople, cottagers, that under no circumstances would take the gas, unless the Scotch system could be introduced of making the landlord fit up the house with gas.

Mr. HASSARD: What would the difference be in the illuminating power of gas upon the works and at 1000 yards from them?

Witness: There would be very little difference with gas of this quality. I should not think that at a distance of three-quarters or a mile from the works there would be a loss in illuminating power of half or three-quarters of a candle. A great deal would depend upon the coolness of the earth, the temperature, and the time of year.

Mr. HASSARD: There was very different evidence given with regard to Brighton.

Witness: I know there was evidence of that kind given, but that is not the result of my own experience. Some experiments that have been made in my knowledge, within a very recent period, showed that in London, at a distance of three miles and a half, there was very little difference in the qualities of the gas at the extremities.

Mr. *Philip Davis*, examined by Mr. MICHAEL.

I am a member of the Town Council of Neath, one of the gas inspectors, and a member of the Highway Board. I am also one of the board of guardians, and am intimately connected with Neath and its gas supply. The gas in Neath has improved very much of late, since the company have taken the management of the works into their own hands. The highway board are satisfied with the existing company. The question of the supply of gas has been brought before the highway board, and a motion was made that our clerk should watch the proceedings of the bill through Parliament, with a view of protecting our roads. They are against the proposed bill passing into law. A petition was brought forward by Mr. Randell in favour of the bill at an adjourned meeting, which was held for a special purpose connected with the sewage of the town. No notice was given of such a matter being discussed, and it is usual to take at an adjourned meeting only the business for the transaction of which the meeting has been adjourned. When the matter was brought forward it came upon me like a clap of thunder, and I wished the meeting adjourned; but the petition was sealed, and I understand with the corporation seal. The present gas company were called upon to light the new road, Windsor Street, and they put the pipes on the ground for the purpose. I am not in any way connected with the company, except as a large consumer.

Cross-examined by Mr. RICHARDS: The gas inspectors called upon the old company to light Windsor Street. I do not know whether it is in darkness now. I believe the works are in progress. I have no knowledge of having moved at the highway board some time ago that a new gas company should have the power of coming to Neath and opening the roads. I know there was something said about it at the time, and I dare say I took part in the proceedings. At that time, from the number of complaints we had, I thought it desirable there should be a new company. I recollect some persons calling and asking if I would sign an agreement, and take gas from the new company, but I cannot tell who they were. I do not think I said that I sympathized very much with the movement, but would rather that my name should not appear, as I did not like to differ from Mr. Gwyn. I did not say this when the gas company came and made application to the highway board to open the streets, or that I should not be able to act more independently, beyond giving them some assistance at the board.

Re-examined by Mr. MICHAEL: I refused to enter into any contract with the new company, because I did not like changes. I am satisfied with what I have, although I am a very large consumer. When the subject was mooted at the highway board it was at the time the Messrs. Bonville had the management of the works, and who gave very great dissatisfaction. The gas is very much improved, and I do not find there is anything to complain of whatever. Obstructions have been placed in the way of the gas company laying down the mains in the road which has been referred to.

Howel Gwyn, Esq., examined by Mr. BURKE.

I am chairman of the gas company, and am magistrate for the counties of Brecon and Glamorgan. I have been high sheriff for the same counties, and was formerly member for Falmouth and Penryn. I have been chairman of the company ever since its commencement, more than thirty years ago. It had its origin in a desire to supply Neath with gas, and for several years we were very considerable losers. We had a manager of the name of Evans, who became bankrupt. The dividends being very bad, we determined to lease the works, which we did to some people of the name of Bonville. I do not recollect the price of the gas at the time, but I know that the Bonvilles did not fulfil their contract satisfactorily. Very great dissatisfaction was occasioned in the town, which induced us to try to put an end to their lease, which we were not able to do without buying them off by paying them a considerable sum of money. We then took the works in our own hands, and we found it necessary to enlarge and improve them considerably, which, of course, required a considerable expenditure of capital. We then asked the consumers in the town to aid us in finding that capital, but none of them would join. While we were in difficulties they all hung back, and left us to find the money ourselves. It has been the efforts of the directors to do their best to fulfil the public requirements, and we scarcely have a meeting without considering how we shall best do this. We do this for the sake of our own interest. We have laid out money in making the works as perfect as possible, in order to supply gas as good as possible. Many persons complain about the gas, but I do not live in the town myself, and merely come into it occasionally. An agitation can be got up for cheap gas very readily. We have already reduced our price considerably, and up to within the last two years we never obtained our maximum dividend. Within a short period we contemplate being able to reduce the price still further. We have tried the different coal in the neighbourhood, and we find Mr. David's the best, and it is solely on that account we use his coal. We have recently obtained additional land so that we may increase the works. Neither the consumers nor the corporation, nor any of the promoters of the present bill have ever asked us to put ourselves under an Act of Parliament. Ever since our existence as a company we have acted by the licence of the public authorities, and it is under their permission we have laid down our pipes, and so long as we were not a paying company they fostered and encouraged us, and never thought of encouraging another company. Now that we are becoming prosperous it appears they seek to ruin us by competition. Supposing this company to get compulsory power to lay down pipes in the streets, and we had not that power, the result might be that they would ruin us. That would certainly not be fair on the part of the corporation. Supposing that we were asked to go to Parliament, we should be perfectly ready to do so, and I pledge myself to it as chairman. I am prepared to state that if the corporation desires it, and this bill be withdrawn or restricted, we are prepared to introduce a bill in the next session of Parliament limiting the price of gas to 4s. 6d. per 1000 feet, and placing ourselves under all the ordinary restrictions required of gas companies. I have no doubt that then we shall be able to carry on our works in such a manner as to give satisfaction to the whole town of Neath. Supposing another company were established, I should think it would be a pure waste of capital, and would not be of any benefit to the public.

Mr. RICHARDS: I am not questioning your word, but how do you propose to bind yourself and your partners as my learned friend suggests?

Mr. BURKE: In the same way as the Chatham Company did last week in another committee.

Mr. RICHARDS: The London and Chatham were an incorporated company. Can you suggest any way in which you can bind yourself?

Witness: I and my brother directors will bind ourselves.

Mr. RICHARDS: You give your word, and no doubt you will perform it if you have the opportunity; but we are all mortal. May I ask you when you first heard of this new company being likely to come into existence?

Witness: I think it was last year, but I do not hear much except when I come into Neath in a morning. I forget when it was.

Mr. RICHARDS: Hearing that a new company was being started last year, why was it you did not come to Parliament, and give your notices in November?

Witness: We did not think this was much of a company. We intended to do it eventually. We heard a talk of a company.

Mr. RICHARDS: Did you hear the suggestion of coming to Parliament until your people got to London?

Witness: Yes; I think we have talked of it. I do not know exactly what the capital of the company is. I think I may say we have got the additional land that has been spoken of. No binding contract has been entered into—merely a letter has passed between us.

Mr. HASSARD: A question has been asked as to how the opponents in this case could be bound to come to Parliament next session. There is a way of doing it, but it has never been tried, I believe, in the case of a gas company, although it has been tried successfully in the case of a railway.

Mr. BURKE: If they are in earnest on their side, and if their endeavour is not merely to establish this speculative company, there will be no difficulty in the matter, because this company are quite willing to enter into a bond with the corporation.

Mr. HASSARD: There is another plan which we have adopted in railway bills—viz., to pass the bill of the promoters, and to put a suspensory clause in it, that the Act shall not be acted upon provided the undertakers came in the next session and obtained a bill for the purpose proposed.

Mr. BURKE: That would be a very expensive mode of doing it.

Mr. HASSARD: It would effectually bind all parties.

Mr. BURKE: I apprehend in a case of this kind, where the whole amount at issue is so small, it would scarcely be advisable.

Mr. HASSARD: Do not imagine that I suggest it. I am only mentioning it as a piece of information.

Mr. BURKE: I know of several cases in which a pledge has been taken even from the chairman of a railway company. I will go further in this case; if the present bill were a *bonâ fide* bill, wanted by the corporation in the interest of the public, so as to obtain parliamentary control, Mr. Gwyn will undertake to sign a bond to come next year to Parliament under a penalty of £20,000. This was at once the object of the promoters.

Mr. RICHARDS: Will Mr. Gwyn give us personally his bond to the extent of £20,000?

Mr. BURKE: Yes; will that satisfy you?

Mr. RICHARDS: I hear you say so, but not Mr. Gwyn.

Mr. BURKE: Parties are ready to sign a bond, and Mr. Gwyn is one of them.

Witness: I will with the other directors, but not alone.

Mr. HASSARD: We have not got the parties to enter into that contract. I think it would be just as cheap for you to take the mode I have suggested, if the thing is to be done at all; but I am not offering you an opinion whether it ought to be done or not.

Examination continued: I believe the board are willing to make application to Parliament, and looking to the interests of the shareholders and this agitation which has been got up, I think it would be about the most beneficial step that could be taken, and one that would give better security than anything else; and even without the pledge I think it is a step we should be disposed to take. We have, without an Act of Parliament, acted to the best of our ability for the benefit of the consumer, and we have not felt the necessity of an Act of Parliament to compel us to do so. It is only because other parties urge the necessity of it that we say we are willing to apply for an Act. I think our capital is something between £7000 and £8000.

Mr. RICHARDS then replied on behalf of the promoters of the bill. He said his learned friend had told them that he had a number of witnesses behind, and he put it to the committee to say whether he should call them or not. Of course he would have to exercise his own discretion in the matter, but certainly it was somewhat remarkable that although the petitioners had put their chairman, Mr. Gwyn, into the chair, they had not thought proper to call their manager. He should have thought they would have called him in the ordinary course, considering they had not had any person who could tell the committee what the capital of the old company was. It had been put into the mouth of Mr. Gwyn that the capital was between £7000 and £8000; but it was perfectly obvious that Mr. Gwyn, in his position as chairman, did not attend more to the affairs of the company than a gentleman living in the outskirts of the town would be likely to do; and until Mr. Burke put the suggestion to him, he did not know anything as to the amount of capital; and it was rather a remarkable thing, considering that one of the questions referred specially to that court—as to the production of gas, the dividend, and so forth—that they had not called their manager or any other person to prove either the cost of production or the amount of capital on which they had declared their dividend. This was a somewhat remarkable circumstance; but, in truth, it seemed to him that the position which Mr. Burke took really rendered the question as to what had been the proceedings of the company, what had been their price, and how bad their gas had been—and he thought there was evidence enough to show that it had been most execrably bad—perfectly immaterial, because his learned friend, as it were, pleaded guilty to the indictment of having had bad gas up to a certain period; at any rate he said—"True, that may well happen that the gas has been bad, that the price has been high, and what not, but still we are willing to be put under an Act and under ordinary parliamentary restrictions, and so to put ourselves into the position which is everything that the inhabitants of Neath can desire, and everything that the intended company could do for themselves." It was quite clear, he thought, that they knew where that suggestion came from; he would undertake to say, as much as if he had been in the room at the time the conversation took place, that his learned friend, Mr. Burke, was the first gentleman who ever suggested to the directors—that was, partners, for directors there were not of the Neath Gas Company—that they must, if they intended to exist at all and to be recognized by any parliamentary committee, put themselves under parliamentary restrictions; and he it was who suggested the course which he then advised. Mr. Gwyn said he believed that the matter had been discussed, but could anybody

doubt that at the time when Mr. Gwyn came up to London it had never been determined, and never scarcely discussed, the question of their going to Parliament; but it was put to him there—"Are you prepared to come to Parliament next year?" his learned friend having, no doubt, told him, as he, the learned counsel, had advised clients himself over and over again, if they expected to be allowed to continue to exist, they must go to Parliament and put themselves under parliamentary restrictions. And why had they not come already? Why did they not come this year? His friend was oppressed with that, and therefore he said, "We by concert got up this company." Why, in March, in a county paper, the promoters were telling the town of Neath of it, and Mr. David, he believed, told them that somebody whose name he forgot called on him with reference to the establishment of a new company; and it was perfectly well known that a new company was about to be established. That existing partnership at Neath, if they ever intended to go to Parliament, could have gone and given their notice by November last. They had ample opportunity of doing so. They (the promoters) were told that they did not come and tell them that if they did not they would set up a competition that would probably be injurious to them. The promoters did not go and ask them, certainly, but they might have gone, and it was perfectly clear until they came up to town they had no idea of putting themselves under parliamentary restrictions. If proof was wanting of it, let the committee look at their petition. What did they say in that petition? Did they say one word about its being their intention to go to Parliament? although it was prepared long after they had had the opportunity of doing so. They pretended to tell the promoters that if they went to Parliament they might injure themselves by entering into competition with them; but in their petition not one word was said about their intention to go to Parliament, or of recognizing it as a duty on their part that they should go. The learned member of the court who sat upon the left of the chairman (Mr. Hassard), who had had large experience in these matters, had suggested a mode by which that could be made binding by the suspensory bill, but he (the learned counsel) was not aware that such a course had been pursued in the case of a gas company.

Mr. HASSARD: I do not think it ever was.

Mr. RICHARDS: However, such a course would be perfectly possible, and he was sure that nobody was more competent to say how far it would be satisfactory and binding than the honourable member who had suggested it. He (the learned counsel) did not say anything against the *bona fides* of any pledge given by Mr. Gwyn, but these gentlemen were gentlemen they could not bind, from the very nature of their position, being there in mere co-partnership. His learned friend had talked very grandly about the £20,000 bond. He (the learned counsel) did not catch Mr. Gwyn's assent to the signing of that bond, and if Mr. Gwyn was animated by like feelings with himself, he could easily understand that, sitting in a chair as a witness, he was not anxious to take upon himself a liability to the amount of £20,000. As to that partnership, nobody knew what might happen; in a legal sense they were absolutely intangible. They could not catch hold of them and impose any obligation upon them as they could in the case of a corporation. In the case of the Chatham and Rochester Gas Company, which was considered by the very committee who declined to hear this case, the facts were really different. The preamble was rejected because the parties sought to take land compulsorily, a question which did not arise at the present time, and which had nothing to do with the present case. But he would ask if those gentlemen (the petitioners) having, no doubt, the goodwill to go and put themselves under parliamentary obligations, even assuming it could be done, at whose instigation did it arise? It arose from the pressure that had been put upon them by the bill. If it had not been for the bill they never would have gone. The pressure that had been put upon them by 700 ratepayers representing a large proportion of the rateable value of Neath, who were partners in the new undertaking, had really wrung and exacted from them the promise to do what it had never occurred to them to do till they had received the very good advice of his learned friend upon that point. He would say that very great consideration was due to the inhabitants, who had put themselves in that position, and who had wrung that promise from them, having endured the proceedings of the old company as long as it was possible, and who had a fair case to go to Parliament and say, "We have a right to ask for an incorporated company under parliamentary restrictions—a company whom we can compel to give good and proper gas." Those gentlemen forming the partnership really had no existence of which the court could take cognizance, and they would not have been there if the objection had been taken at the proper time upon their *locus standi*; and although the objection was not taken upon the *locus standi*, and they had been heard, he said they had not that existence of which they, sitting there as a parliamentary committee, could take any cognizance of. His friend had talked a great deal of the double capital. It might be perhaps very desirable for the existing company that they should continue to enjoy the monopoly which they had hitherto enjoyed—giving bad gas, and charging a price for a considerable number of years far beyond what had been charged in the immediate neighbourhood; but he submitted that the promoters had made out a fair case, and he trusted that the preamble might pass.

The room was then cleared, and on the readmission of the parties,

The CHAIRMAN said: The committee are of opinion that the bill ought to be proceeded with. They will require that the testing-place be provided 500 yards from the works; that no notice of testing be given, but that it take place in the presence of an officer of the company, and that the minimum pressure be not less than one inch at any time.

Mr. RICHARDS: You mean that the officer is to be at liberty to be present, because, if it must be done in his presence, he must have notice.

Mr. HASSARD: No; what we have in view is, what was done in the Brighton case, where the company were compelled to provide a place for the testing, that the officer should be present; that, in fact, the authorities should have access at all reasonable times for the purpose of testing, but that it should be done also in the presence of an officer of the company, in order that it might not be said that it was done behind the back of the company; and it was to be at reasonable times, because the officer should not be required to attend at unreasonable times.

The bill, as amended, was taken before Mr. Dodson, the chairman of Ways and Means, Mr. Kinnaird, and Mr. Hussey Vivian, on Tuesday, and passed as an unopposed bill.

Miscellaneous News.

BOMBAY GAS COMPANY, LIMITED.

The Fourth Ordinary Meeting of this Company was held at the London Tavern, Bishopsgate Street, on Monday, May 28—D. T. EVANS, Esq., in the chair.

Mr. MARSHALL (the secretary) having read the advertisement convening the meeting, the seal of the company was affixed to the register of shareholders.

The following report and balance-sheet, having been previously printed and circulated, were taken as read:—

Your directors, in meeting the shareholders for the fourth time, have pleasure in presenting a statement of accounts made up to the 31st of March last, duly audited, with a report of the progress effected during the year.

The shareholders were advised, by letter accompanying the dividend warrants in November, that the lighting of Bombay with gas was successfully effected on the 7th of October last, and from that time to this, as advised by our manager, "we have been so fortunate as not to have an accident of any description, either in the manufacturing or distribution of gas"—a circumstance the more gratifying and surprising, when the magnitude of the works and the difficulties surrounding such an undertaking are borne in mind; "and the quality of the gas" is reported "to have given universal satisfaction."

The manager's report states that all the works in progress this time last year "have been finished, and are in a satisfactory state of action; and the whole of the company's buildings, machinery, and apparatus are in excellent working condition."

Since the last annual report, when the length of main-pipes laid was 33 miles 414 yards 1 foot, "there have been laid in the public roads, and in the bunders of the Harbour and Pilotage Board, a further length of 5 miles 1601 yards 1 foot of mains and pipes."

Taking into account the fact that Bombay has passed, during the past twelve months, through a financial crisis of the most disastrous and embarrassing nature, your directors have reason to be satisfied with the extension of private lights; whilst the demand by the municipality for public lights has been greater and more urgent than your directors have been able to keep pace with.

The number of consumers "lighted" was on the 28th of April last—

Private consumers	111, with 3516 lights.
Public lamps	438, " 438 "
Number of lights in course of fitting	1147.

The board calculate on erecting full 1250 public lights by October next—within a year from the opening of the works; and it is expected the municipality will require double that number.

It will be satisfactory to the shareholders, who must be aware of the heavy cost of maintaining, and the extreme difficulty of managing European skilled workmen in India, to learn that the natives, the price of whose labour bears an insignificant proportion to that of Europeans, are being trained successfully for the work of main-laying, fitting, and other duties. The municipality having called on our manager to lay a main along Nagdavie Street—an important thoroughfare, upwards of half a mile in length—the whole of the work was performed, to his entire satisfaction, by native workmen.

The expenditure in Bombay, and the outlay at home for coals and fittings, having been greater than the funds called up would meet, your directors found it necessary to exercise the power reserved to them in the Articles of Association, by the final issue of 10,000 shares of £5 each, the whole of which were taken up by the shareholders.

George Palmer Robinson, Esq., has resigned his seat at the board on proceeding to India. Charles Frederick Collier, jun., Esq., and Henry Young, Esq., retire from office by rotation, and, being eligible, offer themselves for re-election.

Dr. *Balance-Sheet* (*Bombay, January* 31, 1866*; London, March* 31, 1866). *Cr.*

To Capital authorized—				By Construction account	£147,376	1 6
(50,000 shares, at £5 per share, £250,000.)				Interest paid to shareholders	14,737	7 2
30,000 shares, £5 per share called up and paid	£150,000	0 0		Office furniture	418	0 4
10,000 shares, on which £4 per share called up	40,000	0 0		General charges, including directors remuneration, salaries, wages, rents, rates and taxes, and other expenses in London and Bombay	4,580	3 2
9806 shares, on which £2 per share called up	19,612	0 0		Stock in trade—viz., coal, service-pipes, fittings, meters, tools, and sundries	41,810	6 2
	£209,612	0 0		Goods *in transitu*	5,177	14 3
Calls paid in advance	1,971	0 0		Balance at bankers	5,598	12 11
	£211,583	0 0				
Less call unpaid	3,818	0 0				
			£207,765 0 0			
Interest			1,974 9 10			
Gas-rental	£1,025	3 7				
Coke sold	489	6 6				
Lime and old materials	188	12 3				
Miscellaneous receipts	67	5 8				
			1,770 8 0			
Sundry creditors			8,188 7 8			
			£219,698 5 6		£219,698	5 6

The CHAIRMAN: Gentlemen, the anuual reports furnished from time to time with the accounts and circular letters which you have received, have advised you of the proceedings of the company up to twelve months ago. The present report speaks for itself, and I now propose to supplement it by some particulars that may be of interest to you. I should tell you, though the fact is mentioned in the report, that the works were opened for the first time to supply gas in Bombay on the 7th of October, 1865, and I am happy to state that this was effected without any casualty. From that time to this the works have been carried on satisfactorily; they answered every requirement, and have fully borne out all our sanguine expectations, reflecting the highest credit not only upon the engineer who designed them, but also upon the officers of the company who carried them out. Before we opened our works a very grave matter arose for consideration, which was the price we should put upon our gas, both for the public lights and for private consumers. That question had our anxious consideration, and we took the best advice upon the subject, having regard to the fact that we were legislating, so to speak, upon unknown conditions. We came to the conclusion that seven rupees for private consumers and five rupees for the public lights would answer the reasonable requirements of the company; and we have no reason—although we have had some pressure on both sides to alter that determination—we have, I say, seen no reason up to this hour for changing the price resolved upon in the first instance. Now, some

anxiety may very naturally be experienced as to the amount of our success. I shall have something to say upon that, and I shall call upon our engineer, Mr. Hawksley, who can speak on this point with far greater authority, as having had very extensive experience, both at home and abroad, in the conduct of works of this nature and the difficulties which are always to be expected in the outset of such an undertaking. The number of our customers as you have been advised in the report, was, up to the 28th of April last—Private consumers, 111, with 3516 lights; Public lamps, 438; Lights in course of fitting, 1147; making a total of 5101. Our manager, Mr. Proud, referring to this subject, writes us, "I look forward to the municipality being our best customers and our main reliance for consumption for some time to come. Our excellent municipal commissioner, Mr. Crawford, informs me he has power to raise, under the Act, £25,000, or 2½ lacs of rupees, for lighting the city, per annum, the whole of which sum he proposes to expend in gas alone. The payment for the posts, lamps, and lamp-fittings will come from another fund distinct from the lighting-rate. It is of the utmost importance that the lamps should be erected with all possible despatch." And here I may say, in parenthesis, that it was no fault of ours that a very large number of lamp-posts were not actually in Bombay at the time when we first lighted the city. We sent out some hundred lamp-posts of a very neat pattern, which did not, however, satisfy the Municipality, and we had afterwards to send out a more expensive sort; but I may add the 400 first sent have been subsequently utilized. Mr. Proud tells us "the change in the municipality under the new Act was alone the cause of delay in ordering the lamp-posts and lamps, which order was not given to me till the 8th of September, 1865. The result is that no part of the order has been executed or delivered, but it is daily expected. On the arrival of the lamp-posts, all the fitters will be started, and if possible the lamps will be lighted at the rate of 300 per month." I think, gentlemen, this will satisfy you that the board have made every provision for lighting the public lamps at the very first moment they had power to do it. Now, of course, in an undertaking of this nature, the gross material from which we are to derive our profit is a question of very grave consideration, and that question is the question of coals. The experience in this country is very clear and well defined as to the coals that are best suited for distillation into gas; but it is another thing when you have to send your coals 14,000 miles over sea, where they must deteriorate more or less in their passage, and when from the climate and the heat, they may change for the worse and lose their productive character. We sent out 4000 tons of coals at a time when freights were extremely low, and those 4000 tons have cost us—insurance, freight, and everything included—less than 40s. per ton in Bombay. The price of coals there on the 28th of March was 35 to 40 rupees, or about £4 per ton. We were tempted to go beyond our charter and become for once coal merchants, and by so doing we might have realized nearly cent. per cent. But we resisted, and I believe wisely resisted, the temptation, for, from the increased demand upon us, we might have actually run short. We are now about to resume shipments of coal. We have ordered 1000 tons, and shall have to send out 500 tons a month for some time to come. Acting under the advice of our experienced engineer, we have appointed an agent at Newcastle to look out for freights from time to time, so that we shall not be obliged to make shipments under pressure, but will be enabled to do it at the lowest possible freight. I should say, while on the subject of coal, that the chairman of the Oriental Gas Company, as I understand, stated at one of their meetings that the cost of their coal was not above 20s. per ton. Of course I do not challenge the accuracy of his statement, but I believe the explanation is that that company get coal from a native coal-field down the East Indian Railway. But we have no such advantage, and we have had to look out to see whether there was any place in the East from which we could procure a supply well suited for gas purposes at any sensible reduction of price. The directors have made inquiries through me of a company called the Australian Mining Company, working the Newcastle coal-field, in New South Wales. I had seen a Blue-book, published under the authority of the Colonial Office, which stated that, though those coals possessed little heart or body for steam purposes, they contained a large amount of bituminous matter, and were well calculated for making gas. The Australian Mining Company have opened large collieries at Newcastle, about 70 miles north of Sydney, and the coals there obtained are Thleir, the coals specially referred to in the report. An application was made by me, on the suggestion of the board, to the directors of that company, who, acting in a very liberal spirit, have furnished us with a trial cargo of coals, which, as far as I know, is now on the high seas between one port and the other. This they have done as a pure experiment without any cost to us beyond their bare economic value, unless the result should turn out favourably. We also applied to another company, the Chinese Steam and Labuan Coal Company, and they have responded by sending, at their own cost and charge, a cargo of coal for trial in Bombay. So that in point of fact we have these two strings to our bow, and I may say, and say authoritatively from the communications I have had with them, that if we should find either of these coals available for our purpose, it will make a difference of perhaps £1 per ton. Now it would very naturally interest you to know, independently of the quantity of gas we can get out of one ton of coal, in what manner we are able to utilize the residual products, and on this point I am able to give you information which is eminently satisfactory. The price realized in Bombay for coke, which is the largest product in the manufacture of gas, was upon the 28th of March, 31 to 33 rupees per ton. The directors thought it might be advisable to get a wider competition for this article in Bombay, as there are many steam-engines and spinning mills there. We therefore resolved to try a sale by auction, and the effect was good, for the coke which before realized 31 to 33 rupees, fetched 35 to 36 rupees. Our produce at present is 120 tons per month, and we only sold the produce of one month. Mr. Hawksley has made some useful suggestions to me on this question; he is looking with very anxious interest to the best mode of keeping down our expenses at Bombay, and of utilizing to the fullest extent the products. He has made amongst others some valuable suggestions on the question of waste; for you must remember that our coal is mainly distilled by that which comes out of the retorts—the coke. Another residual product is tar, and that is not an inconsiderable item. I should tell you that we were somewhat unfortunate in the first instance in this regard, for our contractors, when they handed over the works to us, had left the tar-wells insufficiently puddled, and not, in point of fact, tar tight. We called upon them to make good the deficiency, which they have done; and we have also instructed our manager out there to call upon them to recoup us the loss we sustained by the leakage, and I have no doubt we shall be able to indemnify ourselves, as we can set off the amount against the money due to them under the contract. We are told by Mr. Proud that tar sells, for cash, at 5 annas, or 7½d., per gallon, and that there will be an increasing demand for it as the article becomes known. Mr. Collier, who lived many years in Bombay and is thoroughly acquainted with business there, tells me that the price will be greater and the demand will extend. The other residual products are ammoniacal liquor and spent lime. The former is utilized in this country, but it requires what we are not at present in a condition to attempt—the erection of chemical works. Therefore at this moment it would be unwise for us, carrrying on business in a foreign country, where skilled labour is very expensive, to think of utilizing it. The spent lime also we have not yet been able to turn to profitable account. Having referred to these matters, I now come to speak of the income in gross that we are at present deriving from the lights we have actually set burning in Bombay, and I take this on the authority of Mr. Hawksley. Up to the 28th of March our revenue was at the rate of from £15,000 to £20,000 a year, and I really think, if you consider that we have not been at work for six months, and that we are lighting a distant country, where the natives themselves are entirely unused to the article we supply, and where considerable sums of money had already been expended in chandeliers and oil-lamps, this is a result by no means to be despised. Our profits on fittings, of which we have sent out several thousand pounds worth, have been fair and will be considerable; but we have thought it desirable to reduce the profits upon fittings, and we have instructed our agent out there accordingly, in the hope of thereby extending the demand for gas. In the report which we have received from our manager Mr. Proud, he says, "I have every confidence in the future prospects of the company. The present flat state of business is attributable to the terrible crash which Bombay passed through last year, and which still presses on the public. I believe this alone is the cause for our not receiving orders for private lighting in greater numbers." Well, gentlemen, I may further tell you that, in addition to the Municipality, there is in Bombay a Harbour and Pilotage Board, whose duty it is to light up the whole of the bunders and the water service of the place. We have erected 500 public lamps, and we shall proceed at the rate of 150 or 200 a month. With regard to the private lights, I should tell you that there is a considerable, and will, we hope, be a still greater, demand for gas in connexion with weddings and festivals, not only amongst the native but amongst the European portion of the population; and at a ball recently held at the Byculla Assembly-Rooms there was consumed no less than 50,000 cubic feet of gas. We light the exterior of the temples also, and one of them alone requires a belt of 1000 jets, which is a supply beyond the 3516 private lights of which I spoke before. We have laid pipes to and are in course of lighting two of the Great Indian Peninsula Railway stations; and we are also in course of lighting two stations of the Bombay and Baroda Railway with a large number of burners. I may say that I have always looked forward to the railways as being amongst our best customers. We shall, if I have been correctly informed, be shortly called upon to light up a new market about to be erected in Bombay, and we have already lighted up the Government House at Parell and Malabar, the Post-Office, the Mint, the gaols, the general hospital, the Byculla Club, several banks, newspaper offices, spinning mills, hotels, bazaars, and bungalows. So, you see, we have been making every exertion to extend the operations of the company, and our efforts have been very successful. With regard to the quantity of gas consumed, you will be interested to know that we supplied in the month of January last 1,211,900 cubic feet; in February, 1,364,600 cubic feet; and in March, 1,620,000 cubic feet. We have sent out some brass-finishers in the hope that both Europeans and natives will convert their chandeliers into gasseliers, and we are affording every facility for the purpose. Of course, when persons have laid out large sums of money in fitting up their houses, there must be some extraordinary persuasion brought to bear to induce them to change from oil to gas, and we are adopting the best course we can to facilitate that object. And now, gentlemen, it will be satisfactory to you to know that we have not up to this moment, notwithstanding the financial crisis in Bombay, incurred a single bad debt. We should have furnished you with a profit and loss account, but we were unable to do that, although we sent out forms for the purpose on the 23rd of December last, and indeed the secretary says there would not be time to do it. However, you may be assured that in future reports you will be furnished with a profit and loss account. This circumstance has rendered it necessary to alter the Articles of Association, so as to give us more time; and it is proposed, after the business to-day has been gone through, to make the meeting special for that purpose. And now, gentlemen, permit me to say that, though no doubt our prospects have been damaged to some extent by the very extraordinary financial crisis and embarrassment which has taken place in Bombay, but for which I think our list of private consumers would have been considerably larger, I think we are justified in looking forward with confidence that things are getting better, and that as prosperity returns the number of our customers will increase, not in arithmetical but in geometrical proportion. I have the pleasure to move the adoption of the report and accounts.

Major GORDON seconded the motion.

Major ROBINSON inquired whether the chairman could give the proprietors a rough estimate of the profits of the company—whether they were earning their 5 per cent.

The CHAIRMAN said he would remit the question to Mr. Hawksley, who would no doubt be able to give a satisfactory reply. But he would remind the honourable proprietor that the expenses of the company were now at their maximum, and that even when their earnings became very much larger those expenses would remain nearly stationary.

Major ROBINSON inquired whether the company had sufficient capital to do any work that might be required, and whether there was a probability that the proprietors would be asked for further calls.

The CHAIRMAN said he had no doubt the company had sufficient capital. There was at the present time £40,000 not called up. It was inevitable that there would be further calls, as the company were still liable for a considerable amount to the contractors for the works, and also to various creditors.

A PROPRIETOR inquired from what source the 5 per cent. paid to the shareholders came.

The CHAIRMAN said it came out of the capital, according to the Articles of Association.

The PROPRIETOR asked further whether, in the event of a large extension of the company's business, an additional gasholder would not be required.

The CHAIRMAN said it certainly would become necessary. The directors were about to erect offices at the works, and the trap rock dug out from the site of a third gasholder would be used in the construction of them.

Mr. HAWKSLEY, in reply to an inquiry, said the works were originally calculated for the supply of 500,000 cubic feet of gas per day. With the two gasholders now in use the works were quite equal to the supply of 20,000 lights. There were now on the books of the company about 5000, and they were increasing at the rate of more than 5000 a year.

Mr. SCOTT said he thought the form of audit of the accounts was somewhat peculiar, and inquired whether, under the Articles of Association, it was considered sufficient. The auditors stated in their certificate that, "in the absence of particulars of stock in trade, the amount under that head had been taken from the Bombay ledger." As this "stock in trade" consisted of a very large amount—£41,810—it was rather a serious matter.

Mr. DEELY (an auditor) said the reason they could not certify to the correctness of that item was that the auditors had not been furnished with the particulars of the account from Bombay.

The CHAIRMAN said he had no doubt of the sufficiency of the form of audit.

Mr. LYSLEY (a director) said the item referred to had been checked by the auditors with the account furnished to the directors in London. The fittings, &c., were put down at their cost price.

Mr. BULKLEY said he had no doubt the majority of the shareholders had read the report as he had done with a great deal of pleasure, and that those present had listened with great interest to the statements made by the chairman. He expressed a wish to know whether the capital of the company, £250,000, would be sufficient to light the whole island of Bombay. From information he had received, he might state that the works had been constructed on the most elaborate scale, and he saw from the balance-sheet that with the exception of about £50,000 all the capital had been called up. Another question was in reference to the "fittings." They all knew that the trade in fittings at Bombay might be made very lucrative, and he should like to know what portion of the paid-up capital had been invested under this head.

Mr. HAWKSLEY replied that about £50,000 was due to stock in trade, which included "fittings."

Mr. LYSLEY said the company had sold about £6000 worth of fittings up to the 3rd of January last. The company's sales had however been injured by the sales of fittings belonging to insolvent concerns.

Mr. BULKLEY asked, with respect to coal, whether the company had a sufficient supply on hand, and also whether they might not sell coal and make a profit.

The CHAIRMAN said the directors had set their faces against trading beyond their charter, and therefore they did not sell coal. They had ample coal in store at Bombay. The consumption had been about 350 tons a month, and was now probably 500 tons; and they had a store which was not only sufficient, but with a liberal margin to meet every demand up to the time when the 1000 tons now going out had arrived.

Mr. BULKLEY said it would be satisfactory if the board could give some remote idea whether the works were likely to be so productive as to pay an increase on the amount of interest now being taken out of capital. He remarked that it was very satisfactory to hear that the company had made no bad debts in Bombay, and that their shares were so well held in England that during the present panic there had been no press of sales.

The motion was then put, and carried unanimously.

Mr. HAWKSLEY, having been called upon by the chairman to reply to some of the questions which had been proposed by shareholders, said: I am asked whether the present works will be sufficient to light the whole island of Bombay. I think not, and I hope not. My expectation is that the works will have to be doubled in a few years in order to light the island; but my conviction is that long before that time arrives the proprietors will be in receipt of a very satisfactory dividend. I should be the last person in the world to recommend that any avoidable expenditure should be made by this company until a satisfactory, indeed a very considerable, dividend has been realized; and not only realized for a single year, but secured for ever. I am very much against unnecessary expenditure, and at the same time I wish always to be just in advance of the public demand. If the time should come, as I expect it will in the next four or five years, according to every calculation I have made upon good data, we shall be in receipt probably of 12½ per cent., and be in a position then to divide 10 per cent., and set 2½ per cent. aside as a reserve-fund. I think it will be then time to consider the question of increasing the future works, and I believe the present proprietary will be only too glad under the circumstances to find money for the purpose. Several matters of importance have been broached by the shareholders, and I think it necessary to say that I speak rather as a proprietor (for I have the pleasure to hold a considerable interest in the company) than as your engineer—I say several questions have been asked to which I think I can give satisfactory answers. In the first place, as to the cost of the works. Now, I apprehend that the entire cost of the works as works, up to the end of the next four or five years, will not much exceed £200,000. I do not include in that the gas-fitting business, because the fitting business will take care of itself, and will return a very good dividend upon the money invested in it. I am now speaking of the works. I estimate, and I think upon very good data, that we shall then have a profit of very little short of £25,000 a year—we shall have an income of quite £70,000, and probably a profit of £25,000, if the business is, as I believe it will be, carefully conducted. If we do that, we shall realize about 12½ per cent., and I think that will be a very satisfactory amount of profit to make. Out of that you will pay such a dividend as you deem proper, though probably you will not desire to divide more than 10 per cent., inasmuch as in all points of view it is well to have a reserve-fund in connexion with works situated at so remote a part of the world. Then another question was asked with regard to the capability of the works. The works as designed will make upwards of 500,000 cubic feet of gas per diem, and we shall be enabled to sell by means of those works about 400,000 cubic feet. In the end, therefore, at our present prices—and I see no reason why those prices should not be maintained—we shall have an income of £90,000 a year. When those works are exhausted, or nearly so, we have upon our own ground, I am happy to say, the means of duplication, for every building and every arrangement has been disposed with a view to duplication; so that there will be no additional expense incurred, as is very frequently the case, in the acquisition of land. We were fortunate to get land at a very moderate price; and if we had to get land now, and in another part of the island, we should have to pay very exorbitantly for it. That is a piece of good fortune, though it may press upon you now, as we have bought twice as much as we want; but it will be of the greatest possible advantage to us on a future occasion. A question has been asked as to the nature of the account, especially whether it represents the profit and loss. There is no profit and loss account at present, nor is it possible to have one till the next annual meeting. At present we are making gas at just about cost price—it seems that our income and expenditure are about equal. But that is a very gratifying instead of being a lamentable case. In all the early months, and in some cases years, of an undertaking of this description, the permanent expenses press very heavily upon the cost per 1000 feet of gas made. Now it is not very long ago since the gas was costing this company £1 per 1000 feet; but in consequence of the increased consumption, the permanent expenses being spread over a larger area, it costs now 12s.; by-and-by it will be 10s., then 9s., then 8s.; and if it does get down to 8s.—which by the exercise of economy and good judgment in the manipulation of the undertaking, the provision of coal, the sale of coke, &c., I expect it will—we shall then be enabled to pay the entire amount of dividend of which I have spoken. These are my views with regard to this undertaking—and I think you will believe from what you know of me in connexion with other undertakings, that I am not of an unduly sanguine character. I look at these things in a very cool sort of way; but I think no company has better prospects of remuneration than this company, and though I cannot say that next year there will be a very large dividend—it is not likely—yet I think it possible that the earnings between this period and the corresponding period of next year may be sufficient to pay more than 5 per cent. I am not dissatisfied, looking at all the difficulty of the introduction of a new element amongst a population like the Indian population—I am not dissatisfied with the amount of progress made. It is true we have not got a great number of separate consumers at present, but we have a considerable number of large consumers, and they will bring the small ones in their wake; and when you see that we have upon the average almost 30 lights upon every meter put up, I think it must be satisfactory to you, not only as regards the amount of business done, but as regards the magnitude of the undertakings which we are called upon to supply. I have no hesitation in expressing my full belief that the undertaking will be a success, and I do not think the present depressed value of the shares—though they have only been slightly depressed, notwithstanding the depreciation of all kinds of stock in the market—at all represents their worth. I would advise every proprietor, therefore, to do as I shall do myself, not sell a single share.

The retiring directors were then re-elected.

The meeting having been made special, a resolution was proposed by the chairman, and adopted, rescinding the 108th Article of Association, and in lieu thereof inserting the following—viz.: "The directors shall, at every ordinary meeting of the company, submit a statement of accounts, made up to a date not exceeding six months before such meeting. Every such statement of accounts shall be accompanied by a report of the directors as to the state of the company, and as to the amount which they recommend to be paid out of the profits by way of dividend or bonus to the shareholders, and the amount, if any, which they recommend to be retained for the formation of a reserve-fund."

Cordial votes of thanks were then presented to the chairman and directors, which the chairman having briefly acknowledged, the proceedings terminated.

MALTA AND MEDITERRANEAN GAS COMPANY, LIMITED.

The Ordinary General Meeting of the Shareholders of this Company was held at the Company's Offices, No. 60, Gracechurch Street, on Saturday, the 2nd inst.—W. NICOL, Esq., in the chair.

Mr. ROWSELL (the secretary) read the advertisement convening the meeting, and the following report and statements of account were presented.

The directors have to report that, since the last meeting of the shareholders, the whole of the preference shares have been taken up.

The progress at the stations continues satisfactory. At Valetta (No. 1 station), the improvement in the working through the relaying the mains and services is very marked, and the increase in the profit at this station over last year is £420, notwithstanding the diminished consumption during four months through the prevalence of the cholera.

At Calcara (No. 2 station), the improvement has been very marked during the last few months. Since the commencement of the street lighting a stimulus has been given to the private lighting, and there is every reason to anticipate that, taking into account the large demand which will be made for lighting the dockyards, this station will ultimately equal in its results No. 1 station.

At Corfu (No. 3 station), the progress has exceeded expectation.

At Trapani, a suitable site has been selected, and the works well advanced. The municipality have already intimated a requirement of 100 public lamps beyond the original number of 200.

At Marsala, the foundations of all the buildings are completed, and the superstructure commenced. A very large portion of the materials required to be sent from England for the construction of the works at Marsala and Trapani have been shipped, and two vessels have arrived, and are unloaded.

The directors have pleasure in bearing testimony to the ability and zeal of all the officers of the company.

Bearing in mind that there is still only one station in full working, the balance-sheet will be considered satisfactory. After defraying heavy charges for interest and discounts, and providing for the required 7 per cent. on the preference shares, a balance remains, sufficient to allow a dividend of 3 per cent., free of income-tax, on the ordinary shares, which is accordingly recommended.

The directors have to regret the retirement through ill health of their colleague, Mr. Hawkins. They have elected Mr. John Romanes in his place.

Lord Alfred Hervey having accepted the invitation of the directors to join the board, the meeting is asked to increase the number of directors to seven, and to elect his lordship accordingly.

General Balance-Sheet, March 31, 1866.

Dr.						*Cr.*		
To Capital				£60,000	0 0	By Preliminary expenses		£1,614 14 3
(£5 per share on 12,000 ordinary shares.)						Outlay—		
£2 per share on 6000 preference shares	£12,000 0 0					No. 1 station	£29,530 10 4	
Less arrears (£2632 since paid)	2,657 0 0					No. 2 „	21,019 19 2	
		£9,343	0 0			No. 3 „	14,367 6 1	
Calls in advance on preference shares		1,445	0 0			No. 4 and 5 stations	4,070 0 0	
				£10,788	0 0			68,987 15 7
Loans on debentures		£9,250	0 0			Extending and relaying mains—		
„ from bankers		2,700	0 0			No. 1 station	£4,676 10 11	
Bills payable		6,625	6 0			Relaying services—		
				18,575	6 0	No. 1 station	1,756 3 5	
Sundry creditors				6,750	11 6			6,432 14 4
Reserve-fund				465	10 10	Laying services—		
General revenue account				1,793	17 3	No. 1 and 2 stations	£3,493 2 7	
						No. 3 station	931 3 2	
								4,424 5 9
						Sundry debtors		4,513 2 3
						Goods *in transitu*		1,368 14 5
						Bills receivable		771 0 0
						Stocks		9,927 16 11
						Cash		335 2 1
				£98,373	5 7			£98,373 5 7

Dr. *Profit and Loss Account, Twelve Months ended March 31, 1866.* *Cr.*

To Coal			£3,658 16 1		By Gas		£ 8,164 7 8
Gas-making—wages			765 5 1		Coke		1,296 15 9
Gaslights—salaries			385 4 0		Tar		51 3 0
Charges on street lights			244 10 0		Meters		35 2 7
Lime and purifying materials			63 4 7		Rental of meters		203 13 5
Wear and tear			555 17 5		Rents		29 19 0
General expenses			664 11 10		Sundries		159 9 1
Rents			26 16 4				9,940 9 6
Bad debts			71 6 8		Profit on fittings		758 13 2
		£ 6,435 12 0			Transfer fees		2 12 0
London expenses	£ 872 2 9						
Incidentals	239 6 2						
Income-tax	19 17 3						
Exchange	264 4 10						
Interest and discounts	793 8 5						
Ditto on debentures	294 13 4						
		2,483 12 9					
General revenue account		1,782 9 11					
		£10,701 14 8					£10,701 14 8

Dr. *General Revenue Account.* *Cr.*

To Dividend on preference shares, to Sept. 30, 1865, already paid	£ 32 9 10		By Balance from last year	£ 43 17 2
Balance	1,793 17 3		Profit and loss, to March 31, 1866	1,782 9 11
	£1,826 7 1			£1,826 7 1
			Balance brought down	£1,793 17 3

The CHAIRMAN said when the shareholders were last called together it was for the purpose of confirming an arrangement which the directors had entered into for extending the works to Marsala, in Sicily. The carrying out of that arrangement had since been in progress, and Mr. Hodgson Jones's report, appended to the directors report, would show the present position of it. The contractors, Messrs. Hanna, Donald, and Wilson, undertook to take the whole of the remaining preference shares of the company, which they had done, and this had been a great relief to the directors, for, as the old shareholders would remember, they were sadly put about for want of capital in the early stages of the enterprise. With reference to the position of the several stations, he might mention that the works at Valetta and Floriana were complete; and during the past year a mile and a half of new mains had been laid, the expense of which was all defrayed. There had been a considerable increase in the supply of gas in these two towns; the number of lights, which in March, 1865, was 4415, was now 5110, showing an increase during the year of 695. The cholera, which prevailed at Malta for about four months last year, tended very much to restrict the operations of the company, most of the shops having been closed and a great many of the inhabitants having left the island, so that to a large extent business was at a stand-still. By their previous agreement the company charged 7s. per 1000 for the gas supplied to the public lights, but they managed for a short time to get 8s. per 1000 for a portion of the military lights. This however was objected to, and the directors had found it expedient to reduce the price again to the rate charged to the municipal authorities. This had made a difference of something over £100, but by the gradual extension of their business it was hoped this would soon be made up again. The engineer reported that the works and mains at these places were in a thorough state of repair. The expenses that would now have to be incurred there were merely those arising out of the demand for gas from private consumers, and it was hoped there would before long be a considerable addition to the number of private lights supplied. The company at first starting had to contend with this difficulty—that the people at Malta entertained the opinion that gas was a very hazardous thing to use, and that there was great danger of explosion; but by degrees they had become reconciled to its adoption, and the result was a large increase in the private consumption during the last year, which it was confidently expected would be considerably augmented in the future. But the principal advantage to the company at this station had been the reduction in the per centage of leakage. From the mode in which the works were originally constructed, or rather misconstructed, the company suffered very much in this direction; but he was gratified in being able to say that the unaccounted-for gas, which at one time amounted to 31 per cent., was reduced in 1865 to 7 per cent. The gas-rental had increased in these two towns by £595, notwithstanding the drawbacks he had mentioned, and which he hoped would not occur again. Another favourable circumstance had been the increase which had taken place in the consumption of coke. Heretofore the inhabitants had employed charcoal, which was manufactured in the woods in Sicily, and for some time they were unwilling to use coke, especially in private houses. That prejudice had been surmounted, and he hoped the impetus which had been given to the sale of coke would continue. Looking to the future the engineer thought they might anticipate this year a corresponding increase in the lights to that of last year; these would include the Lascaris Barracks, the military hospital, extensions to the new opera-house, and about eight new consumers each month. The new opera-house was rather an important addition; the expenses incurred in laying mains and making other arrangements for its supply had added a little to the expenses of the past year. The Calcara station was now in full operation, and the receipts during the past year were £520 in excess of those of the year previous. There were still a large number of places to be supplied, and in the engineer's report the buildings expected to be lighted this year were enumerated. Looking at the statements in Mr. Hodgson Jones's report, there seemed no reason to doubt that Calcara would be as productive as the stations at Valetta and Floriana. As yet the company had not had the full advantage of the supply of gas to the public establishments, as it was only recently that the Government sanction had been obtained for the purpose. At Corfu the number of lights had increased from 222 to 536—314 in the last year. Corfu had produced nothing to the company till this year. The directors had not entertained any sanguine expectations, owing to the change from English to Greek government, that this station would be a very productive one, but they had now reason to form a different opinion. The revenue this year had amounted to £1225, and they had good ground for hoping that this sum would in the future be considerably increased. The unaccounted-for gas was rather under 12 per cent., which, for a new establishment, was perhaps not more than might reasonably be expected. The extensions to mains and street-lamps were, according to the engineer's report, still being carried out, and all further extensions of mains would be left to the option of the company. The charge for gas was being lowered from 12s. to 10s., and an increased consumption was promised. The company had derived an extra profit during the past year of £430 on fittings, which had helped to make up the general account. At Trapani and Marsala of course everything at present had been on the side of expenditure, and since the special meeting in November last the time had been occupied in sending out materials and making preparations for the erection of the works. The engineer's report informed the shareholders what had been done in this respect, and led them to hope that at both these stations the company would do well. Some of the expenses of the company had been heavy during the past half year, especially under the items, "interest and discounts" and difference of exchange, but he hoped they would be able to get rid of the greater portion of this burthen now that they were able to call upon the preference shares. It was gratifying to know that after bearing these heavy expenses and making provision for the dividend on the preference shares, the directors were able to show a balance which admitted of 3 per cent. being divided, free of income-tax, on the ordinary shares. It must be remembered that up to the present time almost, one only of the five stations had been supplying all that they had gained. Taken by itself, probably, the profit upon that station was not less than 10 per cent. As the other stations increased in value, the expenses in proportion to the receipts would be smaller, and upon the whole he thought they had reason to congratulate themselves on the position and prospects of the company.

Mr. H. P. SEPHENSON asked whether he understood rightly that the gas-rental at Corfu was £1230.

The CHAIRMAN said the rental was about £1000; the £1230 was the total receipts from gas-rental and products.

Mr. KING said the only question which arose in his mind was whether the interest paid on works in course of construction ought not to be a charge on capital account, in which case all the revenue derived from works already in operation would go the credit of profit and loss.

The CHAIRMAN said the capital there was debenture capital, and no charge was made in the present account for interest upon it.

Mr. HODGSON JONES said there was a clause in the agreement with the contractors that they were to pay the interest on such debentures as were issued by the company up to the period of starting the works; and for the first twelve months afterwards they were to pay 4 per cent. In the case of the Calcara and Corfu stations, interest had never been paid either directly or indirectly out of capital, so that the whole of the interest had been paid out of the profits of the Valetta station.

The CHAIRMAN then moved the adoption of the report and accounts which was seconded by Mr. ROMANES, and carried unanimously.

The CHAIRMAN moved—"That the meeting approves and confirms the payment by the directors of the interest to the preference shareholders for the period previous to September, 1865, and authorizes the directors in present and future years to pay the said dividend for the six months ending the 30th of September on account of the interest for the whole year."

The motion having been seconded,

Mr. STEPHENSON objected to the proposal, as it was pledging the meeting to sanction payments to the preference shareholders half yearly, whether the company had earned anything or not. He hoped the directors would arrange to hold half-yearly meetings, and, if they did so, there would be no occasion for such a resolution. He moved, as an amendment—"That the directors be requested to convene meeeings of the shareholders and publish the accounts half yearly."

Mr. KING seconded the amendment.

Some discussion arose on the amendment, and the difficulty attending the preparation of the accounts of a foreign company every six months, was pointed out by the chairman, engineer, and secretary. Ultimately the amendment was negatived, and the motion, with the words "out of profits" added, was put and carried.

The CHAIRMAN moved, "That a dividend at the rate of 7 per cent. per annum be paid on the preference shares, for the six months ending the 31st of March last."

Lord A. HERVEY seconded the motion, which was put and carried.

On the motion of the CHAIRMAN, seconded by Mr. CROSLEY, a dividend of 3 per cent., free of income-tax, was declared upon the ordinary shares, for the twelve months ending the 31st of March last.

A resolution increasing the number of directors to seven, and appointing Lord A. Hervey to a seat at the board, was then adopted. The retiring directors, Mr. Nicol and Mr. Romanes, were re-elected; also Mr. Backler and Mr. Daniell, the retiring auditors, whose remuneration for the past audit was fixed at 20 guineas each.

The CHAIRMAN and Mr. BACKLER having acknowledged for themselves and colleagues their obligations to the shareholders for reappointing them, a vote of thanks was given to the directors, and the proceedings terminated.

BRITISH ASSOCIATION OF GAS MANAGERS.

The Third Annual General Meeting of the Members of the above Association was held at St. Martin's Hall, Long Acre, London, on Wednesday, the 23rd, and Thursday, the 24th of May.

The following gentlemen were present on the occasion:—

MEMBERS.

W. Esson, Cheltenham	J. Rowe, Wrexham
J. W. Lacey, Hereford	G. Anderson, London
P. Simpson, Rugby	H. Jones, London
E White, Birmingham	W. H. Willis, Great Yarmouth
G. J. Parkinson, Birmingham	J. Braddock, York
S. P. Leather, Burnley	A. Giles, Manchester
T. Hawksley, London	J. Hutchinson, Barnsley
T. G. Barlow, London	T. Rafferty, Manchester
J. Wood, Bury	John Storer, Stafford
W. Stout, Boston	G. D. Malam, Halifax
Thos. Giles, Cowes	J. Blackburn, Droylsden
W. J. Moore, Malton	J. Eldridge, Richmond
C. A. Craven, Keighley	W. Milson, Wakefield
W. Wright, Shipley	M. Broadhead, Great Grimsby
W. H. Chambers, Lowestoft	R. Dempster, Elland
A. C. Fraser, Colchester	T. H. Methven, Bury St. Edmund's
J. Garnett, Ryde	C. Tadman, Norwich
T. Wilkinson, Drighlington	W. Longworth, Dukinfield
A. Milne, Louth	J. Paterson, Warrington
J. H. Cox, Sunderland	J. Veevers, Bolton
H. Newall, Littleborough	W. Throsby, Lincoln
T. Newbigging, Bacup	J. Somerville, Maidstone
T. Andrews, Swansea	J. Barnes, Rotherham
G. Livesey, Old Kent Road	J. Foxall, Beverley
J. Strachan, Reading	J. Brown, Waltham
D. Braidwood, Ratcliff	A. Wood, Hastings
C. Hawksley, Westminster	G. B. Irons, Gosport
R. Morton, Woolwich	H. Cockey, Frome
A. O. Atkinson, Hull	J. Douglas, Portsea
W. J. Warner, South Shields	J. Church, Chelmsford
R. A. Jones, Dover	J. G. Livesey, Ventnor
J. Marten, Ormskirk	T. Bell, Selby
W. Larkins, Ripon	E. Goddard, Ipswich
W. R. Cooper, Banbury	H. Woodall, Bursiem
G. A. Allen, Willington Quay	W. L. Robinson, Coventry
D. Hunter, Phœnix Co., Greenwich	J. H. Robinson, Leamington
J. Hunter, ditto Greenwich	G. R. Robinson, Leicester
R. Douglas, ditto Vauxhall	C. S. Robinson, Leicester

&c., &c.

VISITORS INTRODUCED BY MEMBERS.

R. Jones, Commercial Co.	W. Sugg, Westminter
T. Kirkham, Imperial Co.	W. Parkinson, City Road
G. C. Trewby, Chartered Co., Westr.	Allan Brown, Portsmouth
W. H. Bennett, Westminster	T. W. Hartley, Westminster

On Wednesday, May 23, the chair was taken a twelve o'clock, by THOMAS HAWKSLEY, Esq., C.E., the President of the Association, who delivered the following

INAUGURAL ADDRESS.

Gentlemen, it gives me great gratification to have the honour of meeting you on this occasion. But I shall have to apologize to you for my deficiencies, as, owing to accidental and unavoidable circumstances, I was detained in the country the whole of yesterday; therefore I have not had the opportunity which I intended to avail myself of to prepare a written address, but shall have to offer you such observations as must be taken to rise spontaneously and on the spur of the moment.

Gentlemen, this is the third time I have had the pleasure of meeting you, and on every occasion I am happy to say the association has gained in strength, in importance, and in influence. We now number—or shall do to-day, if it is your pleasure to elect certain gentlemen whose names will be proposed to you—no fewer than 137 members. At the commencement of the past year our numbers were 105. We have lost only four during the course of the year, and there are now no fewer than, I think, 36 gentlemen who are asking to be admitted into connexion with the association, many of them being persons whom it is very desirable we should have amongst us. This is extremely gratifying, because, when we commenced on a small scale, we possessed among us only country members, and many who would have joined us had they known the precise objects we had in view, kept aloof because, as I have been told, they were apprehensive we should engage in controversial discussions, and not devote ourselves as we ought to do to scientific pursuits, and to the acquisition of that knowledge necessary to enable us to perform our duties both to the public and those by whom we are immediately engaged, in the best possible manner. We now find, however, that all those apprehensions have ceased. The public, as well as gentlemen engaged in the profession we practise, are now aware that we have no intentions, no interests, no motives, beyond those which are of an essentially practical and desirable character. It is quite well known that we avoid all topics which would make us distasteful to any section of the community, whether those connected with gas-works or those who are generally considered to be antagonistic to gas companies—viz., the gas consuming public. Every one is now convinced that this association is one from which benefit will be derived both in respect to the manufacture of the peculiar article which it is the duty of the gas engineer to provide for the use of the community, and also as to the best modes in which that article can be distributed to the community at the smallest expense and with the greatest amount of utility.

Gentlemen, during the past year there have certainly been some incidents which have materially affected us in the profession we exercise. Several matters which we considered on the last occasion have attained a much greater importance than they had at that period. Public conflicts have been going on, and public inquiries have been instituted with regard not only to the conduct of gas-works, but also with regard to the manipulations which are proper to be used with the best effect. We have very recently—and I am desirous particularly to call your attention to that circumstance—we have very recently had an inquiry by Parliament, the object of which has been to ascertain whether it is possible for gas companies to supply the article they have the privilege of delivering in a better way, of purer quality, and at a lower price. Now, gentlemen, we cannot discuss this subject in a political manner, nor, perhaps, very much with reference to the questions of political economy involved in it, but we can do this—and I apprehend this is the special object of this institution—we can ascertain the means by which the ends sought to be attained by the Legislature, the means which are within the particular scope of our profession, can be best employed. We can ascertain by research what are our deficiencies, if there be any; we can ascertain by investigation the means for remedying those deficiencies; and I think that during the past year our time has not been altogether misspent with regard to the attainment of those objects. I know that many gentlemen in this room—perhaps the majority of them—have had their attention directed to one or other of the branches into which that question has diverged. The principal of them are these:—The nature and properties of the coals which are available and which may be used in the different gas-works of this kingdom; the manner in which that coal should be treated for the purpose of distilling gas, and the particular mode which should be adopted in its purification, so as to enable us to deliver it as free as possible from all deleterious compounds. The next important question is that of the illuminating power which it is practicable for a gas company to give to the public, having regard to the possibility of permanently procuring the article from which that illuminating power can be obtained. Other questions also have arisen and have been to a certain extent resolved. Questions had arisen before our last meeting, and experiments on a large scale, attended with results which have led to practical consequences, have since been effected. One of those questions was with regard to the proper mode of treating the public lights; and although that subject is far from being complete at present, yet I think we may now say that we have within our reach, due, I believe, to the inventive power and practical skill of gentlemen connected with this institution, the means by which the difficulties that have heretofore attended the lighting of the public lamps may be in a great measure, if not entirely, overcome.

Other questions have arisen in a different branch entirely, and of these there is one which must be treated here with some delicacy, but which, nevertheless, cannot be altogether avoided. I mentioned, on the last occasion, the peculiarity of the law relating to the rating of gas-works. The law has again been expounded, and again expounded differently from what it had been heretofore done. The consequence is, that instead of approaching to anything like a consistent view or knowledge of what the law on that important subject is, we have arrived only at increased difficulties.

These, gentlemen, are, I think, subjects for discussion, because they very much influence that question which the public regard (subject only to the one of illuminating power, and, perhaps, to some extent the purity of the gas) as the most important of all questions—viz., the price at which gas can be delivered to the general consumer. It is perfectly obvious that, if it should happen, owing to any peculiar view taken by the courts or otherwise, with regard to the rating of public companies, and of gas-works in particular, that the scale of rating is very much increased—and I know that in many cases it is enormously high—the result must be an enhanced cost of gas to the public. We, gentlemen, are gas managers, and therefore this becomes a very serious question for our consideration, because it is a very different thing supplying gas, as I know was formerly the case, at a certain price, subject only to perhaps a ¼d. or a 1d. per 1000 cubic feet in respect to rates, and supplying it at a charge on that item alone of 2d., 3d., or even 4d. per 1000 feet.

We have during the past year arrived, with regard to the important question of purification, at this result: that it is quite possible to relieve the gas from those compounds which, when consumed in the flame, produce sulphurous acid, and thereby give off noxious odours in the room, and also affect, as no doubt that compound does, furniture, and deteriorate books, &c. We have arrived at this, by experiment and by careful examination: that it is quite possible to remove the major part of the compounds by which these deleterious effects are produced. But here, gentlemen, we are landed upon another difficulty: we are landed upon what is called the sanitary question. We find that, in great cities where gas-works are placed in situations from which it is almost impossible to remove the foul lime without producing a nuisance, or to store it upon the premises without making those premises obnoxious to the adjacent residents, we have been compelled to use, for the purpose of purification, oxide of iron. Well now, gentlemen, in those cases—and they are some of the most important ones with which we have to deal—unless the Legislature should permit us to have a freer power than we have hitherto practically had in the use of the materials best adapted for purification, we shall not be allowed, I fear, to bring the purity of the gas to that point which unquestionably, as scientific and practical men, we should otherwise be enabled to do. And I may mention here, because it will not be my duty to read a paper on the subject, some general results which have been attained by actual experiment at Nottingham, these experiments being made for a public purpose not at all connected with the town to which I have alluded. We have found that, by the use of lime alone in the ordinary mode of purification, we can reduce the quantity of sulphur in the gas to about 12 grains in the 100 cubic feet, instead of 20, which is the limit commonly imposed by Parliament upon gas companies. Well, gentlemen, that is very much below the quantity which has anywhere, to the best of my knowledge, been obtained when oxide of iron has been used. But we have found this, that if we wash the gas with ammoniacal liquor, we can bring the amount of sulphur, with perfect ease and without much, if any injury to its illuminating power, down to 8 grains. We find further that, if by the use of pure water we continue the washing, and wash the gas to a large extent, we can bring the quantity of sulphur down to 2 grains in the 100 cubic feet. But that is attended with this remarkable consequence: that, if we attempt that process, we bring gas of 18-candles illuminating power down to 3 or 4 candles.

Now, gentlemen, I mention this, not for the purpose of as it were pronouncing an opinion upon the subject, but to lay before you again what I have once or twice had the opportunity of mentioning—viz., that between the results so obtained there must be a proper mean. It is for you, by experiment and investigation, to determine what that proper mean shall be. And I mention it because I think during the next year you may, most of you, have opportunities of directing attention to the subject; and I believe if you do so you will confer the greatest possible benefit not only upon the public in general, but especially upon the companies by whom you are engaged.

During the past year there has not been, I am sorry to say, a great deal further learnt with regard to the proper apparatus to be employed in the manufacture of gas. There has been something done upon the question of gasholders, something with reference to governors, and something with reference to experimental apparatus. I believe you will have papers upon all these subjects, and therefore it is only for me to draw your attention to them in order to invite you to be present and engage in the discussion upon them. I may, however, state this, that with regard to the experimental means to be employed for the purpose of ascertaining the quality and the purity of gas, there is at the present moment a considerable difference of opinion. One set of experimenters engaged in the research of those sulphur compounds which remain after sulphuretted hydrogen is removed as perfectly as possible from the gas, contend that there is yet left, in some

form or other, about 40 grains of sulphur in every 100 cubic feet. Another set of experimenters, proceeding in a different manner, say the quantity of sulphur left is only about 20 grains, or a little more. Now that, again, is a matter for investigation, and I think that even if we cannot dispose of the question at our present meeting, it is one to which every gentleman should direct his attention during the coming year.

Another question has also arisen, and that is with regard to the admeasurement of the illuminating power of the gas. It is contended, on the one hand, that a standard—a false standard, in fact—should be adopted, simply because it is the standard said to be in use some years ago. On the other hand, it is contended, and I think with greater force and reason, that the illuminating power ought to be found as accurately as possible—viz., that whatever quantity of illuminating power is capable of being developed from the gas, the measurement of that quantity the manufacturers and deliverers of the article ought to have the benefit of. I confess that I am of that opinion, and I am of that opinion quite irrespective of that other question as to what ought to be the minimum illuminating power of the gas delivered to the public. I contend this, and I mention my contention simply as a matter for your discussion, and not because I have any very strong individual views upon the subject. I contend that, as in the case of the Excise, if by any means the Government can find a larger quantity of alcohol in a bottle of wine, as we know they now endeavour to do, for the purpose of levying a certain duty upon it, they are perfectly justified in ascertaining that quantity by the best means they can employ, so, in the case of gas, we have a right to ascertain by the best means in our power the utmost amount of illuminating power that can be educed from it. Now, the carbon in gas surely has the same place in our estimation that alcohol has in wine. Why, then, should we be driven to the employment of means which would give a false result, and would deprive the gas companies of having that credit which is due to them? And why, above all things, should we be driven, in making our experiments, to adopt a process which is especially inapplicable, and not especially applicable, to the kind of gas which may be manufactured from any given character of coal? We know, with regard to what is called the burner question, that a burner adapted to develop the illuminating power of gas produced from coal which in the ordinary process of manufacture would give a result of 12 candles—and there are many such coals in the kingdom, especially in the West of England—is quite unadapted for testing the value of the gas evolved from coal which gives an illuminating power, under ordinary circumstances, of 14 candles. Still more so is this the case when the illuminating power is of a higher character, and still more so when instead of testing gas produced from common coal we have a gas in the manufacture of which cannel coal has been employed.

Now, gentlemen, what I wish to lay before you for your consideration, and in order that it may be the subject-matter of examination hereafter, and possibly the subject-matter of discussion, is this: whether our methods of ascertaining the amount of illuminating power are not altogether wrong; whether the means usually adopted of comparing the consumption of a certain amount of spermaceti with a certain consumption of gas burning in a particular kind of burner, and with a particular kind of chimney, is not altogether wrong—is not, in point of fact, senseless and far beneath the existing state of knowledge and science on the subject; and whether it would not be better (and I think we ought to have some view upon the subject) to alter that method, and to determine the illuminating power of the gas with reference to one common standard without reference to any particular length of combustion. We cannot—and that is known to all of us—we cannot get more light out of the gas than there is in it, but we may develop much less; and what I submit to your consideration is this: whether or not we are entitled to have placed before the public, and to have placed before ourselves in point of fact, the real value of the gas that we are engaged in manufacturing.

I think this is a subject, gentlemen, for grave consideration, not only as regards the rationale of the matter, but also with regard to the importance of having within our own hands the means of ascertaining clearly the nature and character of the best apparatus to be used for the purpose. You will have this evening an opportunity of hearing from Dr. Letheby a great deal, I hope, on this subject; for although Dr. Letheby employs a very obscure title for the lecture he intends to deliver, I apprehend he will develop his views with regard to the particular apparatus which he as a chemist thinks ought for the future to be introduced. I have no doubt there will be amongst you a considerable difference of opinion on the subject; and if there should be, although it will probably happen we shall not on the present occasion have the opportunity of entering upon a full discussion of the question, we have this opportunity—we have twelve months before us in which we can make experiments and investigations, and not only pursue the methods that Dr. Letheby will point out, but in which we can test the accuracy, sufficiency, and general applicability of other methods. I hope this is a matter which will engage your attention earnestly in the ensuing year, and that at the end of that period we shall have the opportunity of learning much, as I have no doubt we may well do, as to what have been the results of your practical consideration and your practical investigations.

I have now, gentlemen, only to mention that the secretary will read the financial report of the association, upon which, possibly, I may have a few observations to make.

The financial report was then presented, and, having been previously printed and circulated, it was agreed to take it as read.

The CHAIRMAN: Permit me, gentlemen, to say, and I do it with, I had almost said, reluctance, that it is a matter for your careful consideration, although not for immediate determination, whether we have not now arrived at such a position that we might with benefit to ourselves, and with a due regard to the future interests of the institution, and also having regard to the many members who are likely to join us hereafter, increase our subscription from half a guinea each to one guinea each per annum. I have very great reluctance, I assure you, in suggesting that we should depart from our original intentions, but it is thought that many members, and it is known that many members, are desirous of having our Transactions published for their use in a better and more perfect form than that in which they are now presented. They think the papers ought to be published in the way that the Transactions of learned societies are generally published, and that they ought to be illustrated by some engravings to exhibit clearly to the minds of the members the particular apparatus which may be the subject-matter of our papers. I feel that that is a very important question, and while, for one, I agree with the committee upon this subject, I also agree with them in the belief that it is a matter not for the determination of the committee, but for the determination of the members generally. The committee do not propose to take any sudden vote upon the question, but if it be deemed desirable by the body at large, they will be pleased to offer them the opportunity, either to-morrow or the succeeding day, of giving an expression of their opinions upon the subject. Therefore what is now proposed is simply this: to acquaint you with the fact that it is thought desirable that the subscription should be increased, and to announce to you that unless the matter is very generally disapproved, which I think it is not, they will to-morrow submit to you a proposition for the purpose, and take your vote upon that question. Another matter has been discussed in the committee which it may also be interesting to mention, but upon which again the committee desire to have, as far as possible, an expression of your views. It has been suggested—and every one, I believe, thinks that the matter of the suggestion is an exceedingly useful one, but there are doubts entertained as to its practicability, or the success which would attend an endeavour to produce the result which the suggestion points to—whether there should or should not be an exhibition of apparatus and materials, and also of appliances of various kinds used in the manufacture and distribution of gas. Now we are all individually anxious to see brought together the principal inventions—those which have received the acceptation of ourselves and of the public generally, also those which are proposed for future use by the many ingenious gentlemen who are connected with this association. We are not perfectly satisfied whether, at the present moment, the institution is old enough and strong enough to make such an exhibition successful, nor do we know very certainly where and how such an exhibition ought to be carried into effect. Perhaps a quarter of an hour devoted to a discussion of the question during our sittings would be very beneficially expended. We should like to know what your views are upon the subject; and if it be that you resolve that question in the affirmative, the committee have made up their minds to devote themselves earnestly to the endeavour to make the effort successful. Whereas, if your opinion should be to the contrary, they will at once inform those gentlemen who are not present and who have expressed views upon this subject, what the determinations of the association are. I ought to mention, also, that we are indebted to a gentleman who was entrusted by the committee to inquire inquire into and collect the views of the members, so far as they could be collected upon the subject. I allude to your associated member, Mr. Esson, who has been at a great deal of pains in gathering, as far as he could, from the members of the association, their views upon this subject. There has been no discussion, and consequently the gentlemen who have been written to have only stated their individual opinions. Those opinions have been analyzed by Mr. Esson, and are given at some length in his report.

Mr. J. BLACKBURN (hon. sec.) having read the report,

The CHAIRMAN said: You see, gentlemen, from this report, the differences of opinion are so great that it is impossible for the committee to deal with the matter. They desire, therefore, to have your collective opinion; that you should discuss the subject at a convenient hour to-morrow, and vote upon it. We shall then know exactly what to do, and, whatever may be your determination, you may rely upon it the committee will do their best to carry it out. Well then, gentlemen, the last thing I have to say is that we have received invitations to visit several works, and that we have arranged to meet those gentlemen who intend to accept the invitation, at ten o'clock on Friday morning, on Hungerford Pier. I have now, gentlemen, officially to move that the financial report, which has been taken as read, should be adopted.

Mr. BROADHEAD seconded the motion, which was at once put and adopted.

A large number of gentlemen were then elected members of the association.

The CHAIRMAN said he had now to propose that M. Emile Durand, of Paris, be elected an honorary member of the association. M. Durand was a gentlemen highly esteemed in France, and was the editor, and he (the chairman) believed the proprietor, of a paper similar in character to the JOURNAL OF GAS LIGHTING in England, and he had published several works connected with gas lighting. The committee believed he was a gentleman who would do honour to the association.

The election of M. Durand was carried by acclamation.

Mr. Addison Potter, of the gas-works, Willington, near Newcastle, was elected an extraordinary member of the association.

Mr. GEORGE LIVESEY, of the South Metropolitan Gas-Works, Old Kent Road, read the following paper on

AN IMPROVED METHOD OF PURIFYING COAL GAS.

The work of purification may be divided into two separate classes of operations. The first relates to the removal of those impurities that are capable of condensation, such as tar and ammoniacal liquor; and the second to those which must be removed by combination, such as ammonia, sulphur, and carbonic acid, and their various compounds. In the first place, I am an advocate for thorough condensation to the extent of reducing the temperature of the gas in the condensers to nearly that of the air (say to within two degrees, except in time of severe frost, when the difference is somewhat greater). My reason for condensing so much is this: the temperature of the gas must be reduced in the gasholders and mains to this point; therefore I prefer doing it where I have it under control, and by this means a large amount of ammonia and its sulphur compounds is removed with the condensed liquor, thus relieving the purifying apparatus. For the same reason—viz., that of removing as much of the impurity as possible with the ammonia, I make use of abundant scrubbing power, whereby every trace of ammonia is absorbed before the gas reaches the oxide purifiers, leaving only the remaining sulphuretted hydrogen and a small proportion of carbonic acid; the first is, of course, completely removed by the oxide, and the second—finding it makes no perceptible diminution in the illuminating power—is suffered to remain in the gas. From the preceding remarks my partiality for purifying as much as possible by condensing and scrubbing will have been seen; and this brings me to the object of this paper.

I have for a long time entertained the idea that if some means could be devised for purifying entirely by liquids, it would be a very great advantage; of course it could only be applied by steam power, but this being now so general there would be no difficulty in this respect. I have often been engaged in making experiments with this object, having tried caustic soda, sulphurous acid, and other things, which, from one cause or another, have not succeeded; but I have eventually been led to consider that the ordinary ammoniacal liquor, if any means of efficiently desulphurating it could be discovered, is the best medium for purifying by solution. I was witness, some years ago, to an experiment made by Mr. Laming, at the South Metropolitan Gas-Works, having this object; and here I think it due to him to state that I believe the idea of purifying by desulphurated liquor was originated by him. In the experiments to which I referred he used oxide of iron for the purpose of removing the sulphuretted hydrogen from the liquor, which was accomplished by filling

a box with oxide, and then, running in foul liquor, it was allowed to stand a short time, and then drawn off quite free from sulphur. The liquor thus desulphurated was used in a scrubber, and so purified the gas that on passing it through a second vessel with water only, the sulphuretted hydrogen was completely removed. The same experiment was tried more perfectly at the Great Central, and there, I believe, the ammoniacal solution purified the whole of their gas for some hours. Its wanting success was chiefly owing to the inefficient means of preparing the liquor; the oxide used for that purpose required revivification after every charge, which occupied time; and, again, if this could have been conveniently effected, the fact that the whole of the sulphuretted hydrogen had to be absorbed ultimately by the oxide deprived the process of any advantage. Seeing, then, the failure of Laming's process arose from the want of efficient means of desulphurating the liquor, the next object was to overcome this difficulty. Circumstances led to experiments with the gases or smoke from the flues or chimneys of the retort-house; these gases were pumped into a small quantity of the foul ammoniacal liquor, when it was found that the sulphuretted hydrogen was completely driven off without reducing the strength of the liquor beyond a trifling extent, and this need not be a loss, as, if it is thought necessary, the use of a little water will absorb the escaping ammonia.

Having found a readily available and cheap means of desulphurating liquor, the next point was to prove its value as a purifying agent; for it by no means followed as a matter of course that because liquor desulphurated by oxide purified gas, that this liquor would do the same. The one contained, to a certain extent, caustic ammonia, or at any rate ammonia without its full equivalent of carbonic acid, while the other must contain more carbonic oxide. Experiments were therefore undertaken with this object. In the first experiment three Woolfe's bottles were used, No. 1 containing about 1½ pint of desulphurated liquor, No. 2, half a pint, and No. 3, about a quarter pint of water; through these the foul gas from the condenser was passed, with the result, that 10 feet of gas were completely purified from sulphuretted hydrogen; there was a trace of carbonic acid and also a trace of ammonia, the water not being sufficient to wash out the whole of the latter. This experiment was repeated, with a result that a like quantity of liquor, though of a different strength, purified completely 15½ feet from sulphuretted hydrogen, and the gas was left flowing for some time without being watched, and when next tested the solutions were quite foul, but 26 feet had passed through them.

It was now necessary to try whether a large quantity of liquor could be readily desulphurated; and, therefore, a 5-inch pipe was laid from the retort-flue to an exhauster that was not in use, and from this to a large scrubber charged with coke that had been in use some six or eight months; it was, of course, very foul; being the first the gas entered, it was necessary to begin by purifying this vessel, which was accomplished by pumping in the smoke. The foul liquor was now turned on at the rate of 90 gallons an hour, and gradually increased to 400, which was rendered completely pure as it flowed from the scrubber. The spreading apparatus was not sufficient to distribute more than this, or I believe a greater quantity than this would have been desulphurated. A further experiment has shown that 500 gallons an hour could be desulphurated perfectly, and I hope with the same apparatus to do considerably more than this. So far my expectations had been exceeded. It was then the end of November, the make of gas 80,000 per hour, and at this time the first attempt was made to purify the whole of the gas. There were three scrubbers, each 24 feet high by 15 feet 6 inches in diameter. Two of them were used with desulphurated liquor, the third with water; the quantities used were, of liquor, 600 gallons, and of water, 200 gallons per hour, this being the limit of the pumping power (which had not—nor had anything—been altered for the experiment), whereas I calculated that at least 800 gallons of liquor per hour would be required. Consequently, the experiment did not succeed in purifying the gas of all its sulphuretted hydrogen; but, that it nearly did the work, I judge from the following facts:—The two first oxide purifiers through which the gas was passing were quite foul; on testing after the experiment had begun, the gas before passing through the first purifier stained the lead paper, but at the outlet of the same purifier, where before the experiment it was quite foul, it was now quite clean, and continued so for the first hour; the second box which was also foul before the experiment, showed pure all the remainder of the day (from twelve till six), and on the next morning (the experiment being continued through the night), this box, as near as could be judged, was just in the same condition as before the experiment began. Since that time I have been engaged in adapting apparatus to the process and in making other small experiments, in order thoroughly to test its efficiency. I hope all will be ready before the association meets, that any who please may witness it in operation, and that I may be able to speak more positively as to its merits.

Owing to various circumstances, I have only succeeded in getting a trial yesterday (May 22). The make of gas was 29,000 feet per hour. The three scrubbers were used, No. 1 and 2 with 350 galls. of barely 5 ounces of liquor per hour each, and No. 3 with water. No. 1 removed four-fifths of the sulphuretted hydrogen, leaving very little for the remaining vessels to accomplish, which they did so well that after completely purifying the gas for seven hours, I shut off No. 1 and tried the effect of only one scrubber with desulphurated liquor and one with water, which still purified the gas till I left, at the expiration of an hour, but on returning, four hours later I found it was not quite pure.

I found that four-fifths of the sulphuretted hydrogen in the gas was removed by the first scrubber, and about one-fourth of the carbonic acid, and after passing through the three scrubbers the whole of the sulphuretted hydrogen was taken out and one-half of the carbonic acid.

The thanks of the association were voted to the writer of the paper.

Mr. LIVESEY, in reply to questions by the chairman, said: I tested the illuminating power in the first experiment and found no reduction; that was when we were making 80,000 feet per hour. The quantity of material used on that occasion was 600 gallons of liquor for 80,000 feet per hour; about one gallon to 120 cubic feet. The result was this: the two first oxide purifiers were foul when the experiment began, and immediately after the experiment was started the first box gave a pure test, and continued so for an hour. The second box, which was foul before the experiment began, also gave a pure test the remainder of the day—from twelve to six; but the next morning the second box gave just about the same test as it did before the experiment started.

The CHAIRMAN: You spoke of sulphurous acid from the flues which was the agent of desulphurating.

Mr. LIVESEY: No; it is the carbonic acid from the flue, combined with the ammonia, driving off the sulphuretted hydrogen. Mr. Mann, of the City Gas-Works, mentioned to me the other day that some years ago he attempted the purification of refuse lime by the same means. He took the gases from the flues, and the carbonic acid drove off the sulphuretted hydrogen from the lime.

The CHAIRMAN: That is the common chemical method for the purpose; but perhaps you will tell the meeting what you conceive to be the exact process, and whether you tested the gas before it reached the purifiers, so as to ascertain its condition. How do you separate the action of the purifiers from the action of this agent? You do not give us what the result was before the gas reached the purifier after it had been acted upon by the liquor.

Mr. LIVESEY: The condition yesterday was this: before it was acted upon by the liquor there were 2½ per cent. of sulphuretted hydrogen in it, and 2½ per cent. of carbonic acid by the Cooper's tube. After it had passed the liquor there was no sulphuretted hydrogen at all, and the carbonic acid was reduced to half its previous amount.

The CHAIRMAN: You mean by measuring the condensation of the two?

Mr. LIVESEY: Yes. It was perhaps not a very accurate experiment.

The CHAIRMAN: The process is novel—will any gentleman express an opinion upon it? What is the cost?

Mr. LIVESEY: That I have not gone into, but it will be considerably cheaper than oxide, I think. The cost is only the cost of apparatus.

The CHAIRMAN: Was there any effluvium carried off?

Mr. LIVESEY: The sulphuretted hydrogen carried off by the liquor must be taken away by the chimney and destroyed.

Mr. GODDARD: Perhaps Mr. Livesey would explain to the meeting the manner in which the purification proceeds?

Mr. LIVESEY: The carbonic acid takes the place of the sulphuretted hydrogen. The liquor, as we commonly speak of it, is a mixture of carbonate and hydrosulphate of ammonia; and by passing the smoke through it the sulphuretted hydrogen is driven off entirely and it becomes carbonate. The operation was performed in a scrubber. The smoke was drawn from the flue by an exhauster, and passed into the bottom of the scrubber, just in the same way as the gas. The liquor was passed in at the top, and as it flowed from the bottom of the scrubber it was pure, and the smoke as it issued from the top was very foul with sulphuretted hydrogen.

The CHAIRMAN: Sufficiently so to inflame?

Mr. LIVESEY: No, it did not inflame. I did not try it; but I am quite sure that the great excess of carbonic acid with it would prevent that.

The CHAIRMAN: What quantity of air from the flues did you pass through the liquor?

Mr. LIVESEY: The exhauster was one that was calculated for 40,000 feet per hour; but I think about 12,000 feet per hour were passed through to purify these 500 or 600 gallons of liquor, the proportion being about 20 to 1. I did not ascertain precisely the chemical operation performed. I only inferred it, but I know that it produces carbonate of ammonia by testing with sulphurous acid. The effervescence, I think, showed the presence of the carbonate.

The CHAIRMAN: You did not ascertain the effect of the sulphurous acid. You attributed all the effervescence to carbonic acid?

Mr. LIVESEY: Yes; sulphurous acid could not have done much, because on testing with sulphurous acid the liquor only lost a quarter of an ounce. If the sulphurous acid had produced the effect, the liquor would have been converted into sulphite of ammonia.

Mr. WOOD (Hastings) inquired whether any test was applied to ascertain the quantity of sulphur compounds before and after the experiments.

Mr. LIVESEY: I have not been able to do that. I made a test by Dr. Letheby's apparatus for bisulphide of carbon before the experiments began yesterday, and I set up another while it was going on, but I have not had time to get the result. I mentioned the matter to Dr. Letheby, and he expressed his opinion that some of the sulphur compounds might be removed.

Mr. WOOD asked whether the quality of the gas was at all affected by the process.

Mr. LIVESEY: I cannot answer that at present.

The CHAIRMAN: Is the meeting to understand, so far as your experiment was carried, that 1200 feet of smoke, as you term it, purified 80,000 feet of gas, going through the 600 gallons of liquor intermediately?

Mr. LIVESEY: No, it did not do that altogether. It did not quite purify it. The experiment went on for 30 hours, and I have only arrived at the conclusion by inference; but, as nearly as I could judge, it purified about 24 hours gas. We might say, not speaking from actual facts, it would perhaps purify 12,000 feet an hour. In answer to further questions, Mr. Livesey said the smoke was not blown through in a heated state; it was cooled by being passed through a 5-inch pipe, 150 yards long at least, exposed to the air.

Mr. WARNER: I should like to ask Mr. Livesey to include in the paper, when it is published, some results of his further experiments.

Mr. LIVESEY: We have been adapting apparatus, and I think from this time we shall make the attempt to purify the whole of the gas for the next three or four weeks, and in that time we should be able to make experiments as to testing for bisulphide of carbon. There was a considerable stock of gas in the gasholders. I had no means then of testing the gas as it leaves the scrubbers, but I am having an apparatus fitted for the purpose. If it is allowed to mix with the other gas, you cannot get definite results.

Mr. METHVEN: I should like to know whether it does not spoil an exhauster to have these heated products pass through it.

Mr. LIVESEY: I had to change it several times. There are four beds working into one chimney-shaft, and I take it just as the gases from the beds enter this chimney, so that I may get it as undiluted as possible. The exhauster is at the end of the pipe, so that it may get cool before it reaches the exhauster.

The CHAIRMAN: I will ask on behalf of the meeting whether you will be so good as to test the illuminating power very carefully, so as to see that no deteriorating effect is produced in the operation, and also to ascertain the amount of the other compounds of sulphur remaining in the gas.

Mr. LIVESEY: I shall do it, certainly. When I made the experiments I tested that on one day; but I do not think that is satisfactory. As the experiments will now be continued perhaps for a month, I shall be able to test the illuminating power day by day, and shall then be able to arrive at a conclusion.

Mr. WARNER: This matter is a very important one, and I hope if Mr. Livesey has not completed his experiments by the time that his paper will go to press, he will, on the completion of those experiments, favour us, through the medium of our own journal, with the results. I am sure the association will then feel more deeply indebted to him than they are even at present.

Mr. LIVESEY: I shall be most happy to publish the results from time to time.

The CHAIRMAN: This is so important a matter that if we can send out two or three supplements upon it we shall be very glad to do so.

Mr. LIVESEY produced a specimen of the desulphurated liquor, and

having immersed a slip of lead-paper in it, showed that no discoloration was effected. He also exhibited a bottle of pure liquid ammonia obtained by distillation without the use of sulphuric acid.

Mr. GEO. ANDERSON: I think the association are very much indebted to the writer for this paper, although probably it is to some extent imperfect. I would suggest to him that, before making the further experiments he has spoken of, he should put himself in communication with Mr. Laming, who, I think, understands as much of this subject as any man living, and has made a great many experiments in reference to it. The process up to the point at which Mr. Livesey put the fumes from the retort into the liquor is, as he says, Mr. Laming's process.

Mr. LIVESEY: No; his process was with oxide of iron.

Mr. ANDERSON: Then he desulphurated it by putting the fumes through it. Up to that time the process is Mr. Laming's, and, as I think he has a great knowledge of it, he might give you some very useful hints in connexion with your next experiments. I should like also to suggest that, in your next experiments, you should consider the amount of heat necessary to perform the process for the whole of a gas-work, and whether the heat of the works would be sufficient for the purpose.

Mr. LIVESEY: I will go into all those matters. With regard to Mr. Laming, I may say that perhaps I know as much of him as any one present. We had him ten months at our works making experiments, and I think we were very glad when we had done with them.

The CHAIRMAN: I think we should be very much obliged to Mr. Livesey for bringing forward these experiments, which are not encumbered with a patent.

Mr. LIVESEY: I must correct you there; the process is patented. I do not see the advantage of giving anything to the public, seeing the way they treat one.

The CHAIRMAN: It appears I am wrong, then. At all events I am right in this, that it is not very desirable we should suggest to any gentleman to put himself into communication with any gentleman who may have antagonistic views.

Mr. BARLOW: I think we are all much indebted to Mr. Livesey. I can only say myself, that so far as Mr. Laming is concerned, I followed his experiments for some considerable time, and I came to the conclusion that his failure was due to the large loss of ammonia in the desulphurating process, so that there was not sufficient left to complete the operation.

Mr. LIVESEY: The oxide absorbed so large a quantity of the ammonia. I will only add that I shall be desulphurating liquor to-morrow and Friday, and shall be happy to see any gentlemen present at the works to witness my operations.

Mr. WOOD, of Bury, read the following paper:—

ON THE LIGHTING OF RAILWAY CARRIAGES WITH GAS.

The early modes of lighting railway carriages have for many years been a matter which has caused railway companies no little trouble and annoyance, from the numerous complaints which have been made by passengers, particularly during the winter season, as to the very insufficient manner in which carriages were lighted, the lights from many of the lamps being, as some of the complainants remarked, just sufficient to "make darkness visible." These complaints, however, do not seem to have had the desired effect upon either the officials or directors of most railway companies, or they would, no doubt, have tried the system in use on the Lancashire and Yorkshire, Metropolitan, Great Northern, North London, Manchester South Junction and Altringham, and other railways, or some other system, on one or more of their local or short trains, and if, from the experience thus acquired, found satisfactory, have adopted or improved upon it, so that before now we might have had all trains, and more particularly express trains travelling long distances without stopping, comfortably and brilliantly lighted.

The apparatus used by the Lancashire and Yorkshire and other railway companies is upon Mr. Newall's plan, and consists of a gasholder with the side made of india-rubber cloth in the form of the bellows of an accordion, with flat metal or wood top and bottom, the weight of the top and sides being sufficient to give the pressure required to supply the lights in a train. The india-rubber cloth is protected by straps and rings of iron, which completely guard it from any damage by rubbing against the sides of the box containing the holder. These gasholders are made of various dimensions, and generally placed either in a compartment at the end of the guard's van, or on the top or underneath the carriages. Those used by the Metropolitan Railway Company are on the top; the outlet-pipes to supply the burners run along the roof, and are connected with the pipes on the other carriages by strong india-rubber tubing, each pipe-end having a stop-cock with union, so that the connexion may be easily broken if required. From these pipes smaller ones are carried through the roof to the burners, which are enclosed in glasses so attached to the roof that they may be easily removed when they require cleaning.

During the early period of lighting railway carriages with gas, many complaints were made of the unsteadiness and sometimes sudden extinction of the lights, and not without reason. I have on several occasions seen the light go out suddenly, and have had to travel the remainder of the journey in darkness; but now there is no cause of complaint on this score, and I have frequently travelled on very quick trains, both in the hilly districts and along the sea-coast, when the wind has been strong and gusty, and the gas-lights have remained almost as steady as in the room of a house.

The manner of filling the flexible holders with gas, when a good head of water can be obtained, is by placing as near as convenient to the platform at the station a vessel (the form of a steam boiler is preferred) sufficiently strong to sustain a pressure of from 20 lbs. to 30 lbs. on the square inch. This is connected at the bottom with a pipe and valve to the water supply and to the water outlet pipes. To the top, or to a dome on the top, is fixed an inlet-pipe and stop-cock to receive the gas from the mains, and an outlet-pipe and stop-cock to the pipes for supplying the holder in the carriages. This vessel is first filled with water; the water supply is then shut off, and the gas supply and water outlet opened. As the water is withdrawn the gas takes its place until the vessel is filled; the gas inlet and water outlet are then closed, and the water supply turned on—this compresses the gas to a density or pressure equal, if required, to the height of the column of water supplied; it is then ready for charging the holders in the carriages. For this purpose a flexible tube attached to the outlet-pipe from the vessel is connected to the inlet-pipe of the holder, and, the outlet gas stop-cock being opened, the gas is forced into the holder until it is filled. The gas is then turned on to the burners, and they are ready for lighting.

Another method of filling has been adopted by the Great Northern Railway Company at King's Cross station, the Metropolitan, the South Junction and Altringham, and by one or two other railway companies, which works exceedingly well, but the flexible holders cannot be filled so quickly as by the method previously described. It is as follows:—A supply gasholder and tank are provided, of a suitable size and form—square or rectangular is preferable—made much deeper, in proportion to the area of the top, than holders used at gas-works are, and of such weight as will give a pressure equal to from 20 to 24 inches of a column of water.

A crab or crane, having such a train of wheels that the holder may be lifted easily, is fixed to the floor, with a chain passing over pulleys and attached to the top of the holder. One pipe answers for inlet and outlet, having two connexions outside the tank, with a stop-cock to each—one the inlet from the supply-main, and the other the outlet to the pipes for filling the flexible holders. In filling the supply holders, the outlet stop-cock is closed, and the inlet opened; the holder is then hoisted at a sufficient speed to allow the gas from the mains to flow rapidly into it. When full, the inlet-cock is closed and the holder released; it is then ready to supply gas to the holders in the carriages with flexible pipe, &c., in the same manner as described in the other method. The time occupied in charging one of the flexible holders with gas from the supply vessel first described, when at a pressure of 15 lbs. on the square inch, is about 45 seconds; and, when charging from the supply holder as last described, and having a pressure of 20 to 24 inches of a column of water, the time occupied is about 3 minutes. The time thus occupied is so short, that if filling apparatus are fixed at some of the principal stations where trains invariably stop 5 minutes, there would be ample time to fill up the holders in the carriages before the train started.

Many objections have been raised against this system, some of which I may here mention. One is, that the illuminating power of the gas is diminished by being in contact with the water in the filling apparatus; but this is to such a very small extent that it is scarcely discernible. I have often seen trains lighted with gas supplied on this principle, and there has been no perceptible difference between the lights in the train and those at the station. Another objection is, that the flexible holder occupies too much space.

The holders generally used on the Lancashire and Yorkshire Railway occupy a space equal to one compartment of a second-class carriage—viz., about 6 feet 6 inches by 6 feet 6 inches by 6 feet, and will contain about 240 cubic feet of gas. The trains are composed of two, three, or four sections, and each section of three or four carriages and a van, according to the traffic. One of these sections contains from 12 to 15 lights, and a holder of the capacity named will carry gas sufficient to supply that number of burners for 5 hours, each burner consuming 3 cubic feet per hour; and the holder does not occupy more than one-twentieth of the space of the train. Trains are now running with holders of the same capacity as here described, and supplying the same number of lights, over a distance which occupies 4½ hours to travel, without requiring to be recharged.

Another objection is the liability of the flexible holder to be damaged by constant expansion and contraction. The holders are made of india-rubber and cloth combined; therefore they are not very elastic, and the pressure of gas in them is not sufficient to expand the material so as to injure it. There are holders now working which have been in use for the past five years, and the material seems as good as when first put in.

Another objection is that, if the flexible holders were allowed to remain charged with gas for a number of days, air would pass through the pores of the india-rubber, and, with the gas, form a highly explosive and dangerous compound. This is quite impossible, as the pressure of gas inside the holder is greater than the air outside, and therefore, if the material was porous, the gas would ooze out and empty the holder. The cost of gas in comparison with oil as at present used is greatly in favour of the former; and the increase in illuminating power is with coal gas 400 to 500 per cent., and with cannel gas 600 to 700 per cent.

Other methods have been tried, but have not met with the same success as this. Among these may be classed the high-pressure system. This system would be a great advantage, both as regards the space occupied and the extra quantity of gas that might be carried, if a proper apparatus could be obtained to reduce the pressure from the gasholder to the burner. This has often been attempted, but as yet not successfully accomplished.

Not having seen or had much experience in connexion with any other method of lighting railway carriages than the one described, I do not feel qualified to touch upon any of them; bu tperhaps our friend, Mr. Hall, will give us some information on this subject.

The thanks of the association were given to Mr. Wood for his paper.

The CHAIRMAN: Perhaps Mr. Wood would give us some more exact account of the comparative cost. I did not quite understand how the illuminating power was estimated—whether it was against a certain weight of oil or a certain cost of oil. You say, I think, that the illuminating power is 400 or 500 per cent. in favour of gas manufactured from coal, and 600 or 700 per cent. in favour of gas manufactured from cannel; but are you then speaking of comparative cost or comparative quantity?

Mr. WOOD: It is not as to comparative cost, but amount of light given.

The CHAIRMAN: You think that there is six times the light given by the consumption of 3 cubic feet of gas per hour that there is from an oil-lamp?

Mr. WOOD: Yes, from an ordinary oil-lamp.

The CHAIRMAN: I should not have imagined that.

Mr. WOOD: I made some experiments for the Lancashire and Yorkshire Railway Company with Mr. Fothergill, and this was found to be the fact. We measured the light of six oil-lamps, and found it did not exceed the light produced by gas burning at the rate of 3 feet per hour for six hours. The quantity of oil consumed by the six lamps burning six hours was 1 lb. 3¾ oz. The experiment was made for the purpose of comparing the cost of oil with the cost of gas. The comparative light was measured by the photometer. The experiment could not be made in the carriages, but it was made with a similar burner consuming a like quantity of gas.

Mr. WARNER: May I ask what is the cost of lighting one compartment with oil, and what is the cost of lighting the same compartment with gas, leaving the illuminating power out of the question, supposing that the lights are equal?

The CHAIRMAN: It seems that each consumed half an ounce of oil in an hour, as nearly as possible. Therefore, we can easily make the calculation.

Mr. WOOD: The cost of the oil for the time was a little under 6¼d., and the cost of the gas burned during the same time was 3¾d. That, of course, was not with equal lights. The light of the gas is six times greater than that of the oil. I have here a return from the London and North-Western Railway Company: 17 oil-lamps burning each three pints per week, or 6 gallons 3 pints at 5s. per gallon, £1 11s. 10½d., against an equal consumption of gas, taken on an average of eight weeks = 1525 cubic feet at 3s. 9d. = 5s. 8½d.; difference in favour of gas, £1 6s. 2d.—that is, exclusive of waste.

In answer to the chairman, Mr. WOOD said he could not speak as to the cost of manipulation, nor as to the value of the room taken up in the train.

Mr. VEEVERS: You have spoken of the cost of water. It appears to me

that the plan adopted on the Metropolitan line of a gasholder with weights, would be preferable to the plan in use on the Lancashire and Yorkshire line with water.

Mr. WOOD: No doubt it would be cheaper, but you could not get the gas into the holders so rapidly.

Mr. VEEVERS: It is a very important question—the best mode of filling these chambers; and it would be well for gas managers to be prepared with the best plan, and it is worth discussion whether it should be done by the use of water or steam power or by weights.

Mr. WOOD: The cost would of course be very much increased if, after being once used, the water is allowed to be wasted.

The CHAIRMAN: The water might be allowed to run into a cistern, and be then pumped back again, but in that case the cost of pumping will have to be added.

Mr. WOOD: I am not able to give any evidence as to the comparative expenses. I made inquiries from the Lancashire and Yorkshire Railway Company, to get correct data, but I could not get any information from them.

The CHAIRMAN: I believe you know something about an explosion of one of the gas apparatus which took place at a station some years ago. Perhaps you can give the meeting some information on that subject.

Mr. WOOD: It is some four or five years ago. The explosion took place in one of the boilers—if you can call them so—in which the gas was compressed in this water process. It had not been in use for a week or a fortnight, and the outlet intended for the gas had been opened and the water had been allowed to run away from it. There was a mixture of atmospheric air and gas, which I suppose were in just sufficient proportion to form a very explosive compound. From the information given at the time, it seems that the man who had charge of the apparatus turned on the water, but he could not wait long enough to let the mixture blow out. He applied a light to a half-inch pipe, at the top, and the explosion immediately followed. The explosion did not take place in one of the carriages, but in the filling apparatus. The light was applied directly to the top of the boiler. In answer to further inquiries, Mr. Wood said there are no governors or regulators. The pressure is about 1 inch or 1½ inch. The motion of the train does not cause any oscillation in the holder, so as to affect the lights. One of the holders that was filled with gas contained about 240 cubic feet. The holder is simply a diaphragm of flexible material. There is no tendency in it to become stiff. I have noticed some within the last three or four weeks, and it seemed quite as flexible as new material.

Mr. WARNER: The flexible tubing which is used emits a very disagreeable odour after it has been in use two or three months. Is there anything that can be done to prevent that?

Mr. WOOD: I do not know. I have asked whether any complaints had been made by passengers, and I have been told that no complaints had been received about it.

The CHAIRMAN: There is no flexible holder in the carriage?

Mr. WOOD: No; it is in the guard's van, as a rule.

Mr. BROADHEAD: Is the gasholder made of the same material as the tube?

Mr. WOOD: I think it is the same.

The CHAIRMAN: I do not understand that the compression depends upon elasticity, but that the vessel is like an organ bellows.

Mr. WOOD: Yes, like the bellows of an accordion.

Mr. STORER: I have seen a little with respect to the lighting of railway trains with gas, and it has been found very inconvenient to light a long train with gas where that train has to be marshalled, as they call it, at different stations. That has been found an insuperable difficulty in lighting a train in the way that Mr. Wood has proposed. I think before the lighting of a train with gas is brought to perfection the plan must be for each carriage to carry its own gasholder, of whatever construction that gasholder may be.

The CHAIRMAN: That would obviously increase the cost.

Mr. STORER: Perhaps it would, sir; but I am satisfied that except in the case of a train just running to and fro, without any separation or any change in the position of the carriages, one gasholder will be a very great inconvenience. I have seen it, particularly at stations where two or three trains run in and are shunted to and fro, and marshalled together again before proceeding on their journey.

Mr. WOOD: The Metropolitan Railway Company have their gasholders on the top of the trains, one on the top of each carriage.

The CHAIRMAN: There is another paper upon this subject, by Mr. Hall; but as that gentleman is not here, it must be taken to-morrow morning.

Mr. T. H. METHVEN, of Bury St. Edmund's, read the following paper:—

ON THE MANAGEMENT OF SMALL GAS-WORKS.

By small gas-works, I mean those in towns whose population ranges from 800 to 4000, and in which the work is nearly all done by one man. Their small size, which would lead one at first sight to regard their management as an easy matter, renders it the reverse; thus directors find it more difficult to produce a regular supply of gas and a moderate dividend in them than in those of greater magnitude. This arises from the difficulty in obtaining a man with the knowledge necessary for good management for the small wages the directors can afford to give, and on account of the small margin left for dividend after paying the working expenses, as well as for the limited demand for gas. Notwithstanding the care directors have bestowed, the management of such works has not been good, and it is to assist in preventing the mismanagement so general that the writer has prepared this paper. The subject may appear trivial to some, yet to the inhabitant of a small town it is not so, for good management would often secure to him the advantages of gas, whilst the bad management of neighbouring works would discourage the erection of new ones, and deprive him of the consequent light.

The usual mode of introducing gas into small towns is something like the following:—A few of the principal inhabitants of the town having determined to have it lighted with gas, ask a manufacturer of gas apparatus to supply plan and estimates for the projected works. Meantime the town is canvassed for shareholders to supply the necessary funds and consumers to burn the gas. When the estimates are received, they find that they exceed the amount of capital subscribed for, and the contractor is asked to cut down his plan and reduce his estimates accordingly. Or, it may be, plans or specifications are advertised for, and those which can be erected for the smallest sum are selected, irrespective of their merits.

Either way the result is the same. The works have as few retorts as possible, the retort-house is cramped in its dimensions, there are two and sometimes only one purifier; no meter, no governor; the connexions on the works are small, and the gasholder only equal to the present wants of the town.

A manager is now advertised for, as follows: "Wanted, by the directors of the Smallpost Gas Company, a manager; he must be able to make the gas, superintend the setting of retorts, pump the syphons, water and repair the meters, take their indices, attend to consumers complaints, and collect the gas-rents. Wages 14s. per week, with free house and gas, and a limited amount of fuel. Applicants must apply in their own handwriting, and be thoroughly trustworthy." After some trouble the directors find a man whom they consider a suitable person, and gas is made.

The works are formally opened by a dinner at the chief inn; a band has been hired, the lamps lighted, and the King's Head illuminated for the occasion. Never was there such a notable dinner there before; from the chairman to the village postman, all have been toasted, and all have spoken to the sentiment that a new era has dawned upon the town. Whilst those who are supposed to know most about gas affirm that, in addition to gas at 8s. 4d. per 1000 feet, there will be a dividend of 5 or 6 per cent.

From day to day the directors visit the works, see the coal-heap decrease, the tar-well fill rapidly, and find very little coke set aside for sale. At the end of the year there is no dividend, to the surprise of every one.

But we will suppose that the consumption of gas increases, and that at the end of some years a dividend of 5 or 6 per cent. is reached. Even then the directors are not out of their difficulties, for the gasholder is too small, and the retorts are unequal to supply the gas required; hence, too often in the winter season the gasholder grounds at nine or ten o'clock, or if the manager has the means at his command, and knows how to reduce the pressure, the consumers are furnished the whole evening with a feeble light.

To remedy these complaints a further outlay of money is required, and acting upon the same principle upon which the works were established, another little holder is erected and an extra retort or two set up. The wants of the town are now again supplied for a year or two, when again the same annoyances occur and the dividends again are reduced or vanish. There are many cases where for three or four years there has been no dividend, although the consumption has been large enough to produce one. In addition to these, there has been a great deal of trouble to the directors and an indifferent supply of gas to the public.

Having sketched an outline of ordinary management, it remains for me to indicate, first, how new works should be erected, and second, how both new and old works should be managed properly.

In erecting new works, the services of some one should be obtained who thoroughly understands how to erect a complete gas-work at a moderate cost and to manufacture gas cheaply; it is not enough that he know how to make gas; anybody can do that, yet few know how to make it cheaply on a small scale. The person selected ought to control the management of the works from their commencement, as it is absolutely impossible to find a man for 14s. or 18s. a week who has the requisite amount of knowledge to ensure good management. Thus the directors will have good advice, which will enable them in a year or two to understand their duties, and the secretary and manager be trained to their work, whilst in addition coals and fuel will be saved in many cases sufficient for an ample dividend.

The works when complete should have a bench of retorts in advance of their greatest necessities. The settings should be simple, so that the village bricklayer can understand them and set the retorts easily. Those settings should be avoided which have dampers to shut off retorts that are not wanted, for if these are complicated, however well they may suit works that have good and constant supervision, they are rarely well attended to without it, so that they soon get out of order and heat badly. The condenser and purifiers should have nothing complex about them—each should be an independent apparatus, with caps suitably arranged in case of stoppage. There should never be less than two purifiers, and if possible four; the latter arrangement, besides ensuring pure gas and economizing the lime, enables a washer to be dispensed with, and reduces the gas liquor to a minimum quantity, which in some places is a desideratum.

A station-meter and governor are indispensable; to this no exception should be made, for if these instruments are necessary in large gas-works, they are more so in a small one, where the margin for loss is so small.

A pressure-gauge should be fixed on the outlet main. The coal-shed should be large enough to allow the stock to be easily taken, and be supplied with a portable weighing-machine.

To some it may appear ridiculous to enumerate the above, yet there are towns of 4000 inhabitants which have gas-works without a spare retort, have no meter, governor, or pressure-gauge, and but two purifiers. The dividend has never been above 5 or 6 per cent., although the consumption of gas is large and the price high enough to produce a good one.

It will readily be admitted that no advertisement will produce much ability for 14s. a week, and if even a clever man is found who shows himself a good manager, he will soon find a better place and leave off stoking. The directors will thus again have to select a new man, and run a second risk and the chance of worse management; therefore, the directors would do better to have a consulting engineer, who might be acquainted with some one who would make small gas-works his department, or the manager of some larger works in the neighbourhood. The fee paid for such advice would be many times repaid by the saving effected thereby.

This engineer should have a weekly return of the working sent him, and visit the works monthly, or as often as he deemed necessary. His practised eye would at once discover when retorts were out of order, and his larger experience would in many cases prevent waste in almost every department.

We shall suppose that the works are complete—that is to say, have the retorts well set, and the condensers, purifiers, meter, gasholder, and governor in good working order. The manager should weigh his coals and take the statement of the meter daily, and insert the quantities of coals and gas in a book with columns provided for them. In this should also be inserted the amount of fuel set aside for sale daily. Every three months, or when the state of the coal-shed should allow, the stock should be taken and the result compared with that in the carbonizing book.

The pressure in the street mains should be carefully attended to, and reduced during the day to the lowest limit consistent with the wants of the consumers. This can only be done by a governor. No slide-valve is of any practical use in small works, as, although it is shut down partially, the pressure is not affected thereby; for, from having no pressure-gauge, or, where there is one, from the fear of putting the lights out, the pressure has not in some works been reduced during their whole existence. Every practical man knows that this constant pressure entails leakage proportionate to the condition of the mains.

The consumers meters should belong to the company and be let to the consumers at a fair rental—first, because the cost of a meter will often prevent persons becoming gas consumers; second, because in the event of repairs the meter can at once be replaced by a new one from the company's stock, thus saving the making of joints and other annoyances; third, because the rents paid produce ample interest on the capital employed. The main-cocks and inlet-pipes, as well as service-pipes of ordinary length, should be laid at the company's expense.

The books of the company should be arranged on a clear plan, showing the quantity of coals actually used in the year (not paid for, as has been

done in some cases), and the quantity of gas sold in the same period, and which has been produced from the coals; also the quantity of coke and tar saved and set aside for sale from those coals.

This system would enable the directors to check the annual working by the printed balance-sheet and mark the direction of its progress. It might be objected to that this would enable some cantankerous shareholder to find fault should the progress be in the wrong direction. So much the better, as waste benefits no one, and should be prevented.

Very erroneous estimates of the quantity of coke that can be sold have often been given in balance-sheets produced at meetings when small companies are being formed. Sometimes 22 bushels to the ton have been reckoned, and the gas at 9000 feet per ton. This is absurd, for in works carbonizing 70 tons per annum all the coke saved in the winter time is used during the summer in heating the retorts when the make of gas is under 1000 feet daily; yet in such works gas can be produced at 7s. 6d. per 1000 feet, and 5 per cent. be paid upon a capital of £1400.

It may be fairly assumed that every company whose annual receipts for gas amount to £250 should pay a dividend of 5 per cent. if they will adopt the plan of management above indicated. But many works now pay badly because they are under the management of a stoker, who is again looked after by the village tailor, baker, or lawgiver, who, for the annual sum of £5 or £10, keeps the books, and allows the dividends to go into the tarwell or up the chimney, and who has influence enough to retain his post and salary to the exclusion of better management.

The annexed extracts from the printed balance-sheets of three small companies show the truth of the above remarks. The price of gas is the same in each, but that of coal is less in the last; allowance has been made accordingly:—

A,	coals used, £110;	gas sold,	£193.
B,	" 95;	"	146.
C,	" 70;	"	212.

In A there has not been a dividend declared during the four or five years of the company's existence. In B there has been no dividend; the balance hitherto declared has been on the top side of the account. In C 5 per cent. was declared at the end of the first year's working, and there is a small reserve-fund. An efficient secretary keeps the books, and the works are complete in every respect.

Every one who has studied the subject knows that these cases are not exceptional, and quite justify the writer in introducing the subject. He trusts that this paper, if it presents nothing new, will yet be the means of removing some of the obstacles that prevent new gas-works from being erected, and preventing that waste in existing ones which, while it tends to keep the price of gas high or dividends low, benefits none.

The thanks of the association were voted to Mr. Methven.

Mr. Esson, having been called upon by the chairman, said he did not know that he could add much to what Mr. Methven had brought before the meeting. Most of the members of the association had experienced what Mr. Methven had said in respect to small works, that they were considerably mismanaged. He remembered on one occasion being asked to give his advice to a gentleman, the proprietor of some works, who had been realizing a loss annually, and he found that, though using the best cannel coal at the works, he had only been obtaining 4500 cubic feet of gas per ton. The question was, where it had gone to. On examination he found the mains were leaky, that there were no means of measuring the gas in any way, and the pressure was kept on all day. The first balance-sheet after these things were put in order showed a profit of 10 or 12 per cent.

Mr. Atkinson said that as an amateur he had sometimes been called upon to give his opinion in reference to the management of small gas-works. On one occasion he was asked to advise upon a plan which had been sent in for the construction of some works. He recommended the employment of a good engineer, and the letting of the various parts of the work separately to different contractors. His advice was not followed, but a person was selected who tendered for the whole as one job. Some two years after the establishment of the works he happened to meet the secretary of the company, who in reply to an inquiry told him he did not know how it was, but somehow or other they could not get more than 4000 feet of gas out of a ton of coal. An examination was made, and it was found that the mains were laid in the worst possible manner, and there was, consequently, a great loss of gas. At another place, where the works were very well erected, there was no meter and no governor. Such appendages did not seem to be popular at small works. Directors of small gas-works made a great mistake in not paying for brains soon enough. If they were to act on the principle that brains were just as well worth paying for as wood, brick, and iron, they would save in the end.

Mr. Paterson said he quite concurred in the opinions expressed in the excellent paper just read, but he thought the cases mentioned by Mr. Atkinson must be exceptional. He (Mr. Paterson) had had a great deal to do with small works, and the difficulty he had always found was in tiding over the summer, the expenses of which really eat up the profits made during the winter. During that period most of the expenses of the works were going on, while there was scarcely any return, for in small towns and villages the consumption of gas in the summer was so small that it would not keep more than one or two retorts at work. There was, therefore, some trouble in making small works pay, even though tolerably well managed. Another drawback was the difficulty of securing and paying skilled labour for such works. He believed, however, that the general working of some of these small concerns would compare favourably, as to the quantity of gas produced per ton of coal, with works on a much larger scale. Their difficulties lay rather in another direction. It was the limited extent of the consumption which tended to keep up the price, and this was a great hindrance to the profitable development of the concern. In towns of some magnitude a larger proportion of the working classes were consumers.

Mr. Douglas said the paper had given him much pleasure, because it was the result of experience. The defects pointed out by Mr. Methven were more immediately attributable to the directors of the concern; and in small gas-works he (Mr. Douglas) believed the directors were rather an impediment than otherwise. In those cases in which a properly skilled manager could not be afforded, it would be better for the directors and others interested to give way, and seek the advice and assistance of the nearest gas manager of standing. Not long ago he was applied to by the directors of some small works, in consequence of the gas stinking everybody out of the houses. The manager of the works declared that the gas, after passing from the purifiers, was perfectly free, and did not stain the test-paper; but it was found out that he had been in the habit of letting his refuse liquor run into the gasholder, and the gas thus again took up the sulphur. How was it likely a man engaged at 25s. a week would find that out? Then, again, as Mr. Esson had remarked, in some places the pressure was kept on all day. It was quite impossible for the village tailor or baker to give such attention to the works as a skilled man could do, and he thought it was advisable for the directors of such works to withdraw from the direct superintendence, and look to the manager of the nearest large works for such assistance as he could give. He wished to ask Mr. Methven whether he found that the system of leasing small gas-works had been of any advantage to them. It seemed to him (Mr. Douglas) that a man who held four or five works on lease, and gave his whole time to looking after them, could make a far better return to the respective directors than if they were all under separate management. Perhaps that might be better than applying to an engineer from time to time.

Mr. Methven said that the great difficulty was to get directors to adopt Mr. Douglas's suggestion as to leasing. The village tailor or the village baker stood in the way, for he saw that if the works were leased his occupation would be gone. Besides this there was a great objection in some country districts to any person coming to take money out of the neighbourhood. The people thought that, if there was anything to be made out of the management, they might as well reap the benefit of it; so that, although these works were unproductive in their own hands, on the principle of the dog in the manger, they refused to allow any one else to make them profitable. He believed it would be the better plan if it could be effected, and he was sure there was no difficulty in managing small works if the suggestions he had made were attended to. But it was not in very small works only that the unproductiveness he had spoken of existed, but sometimes in works the receipts from which were ample to produce a fair dividend. As to reducing the pressure during the day, it seemed hardly to be thought about in many works; and, with reference to the use of a station-meter, so little was its value appreciated, that in one case which he instanced a body of directors being urged to erect one, said they did not see how it would enable them to make more gas. It was the want of attention to these matters which resulted in mismanagement and no dividend. There was a great deal of loss occasioned to some small companies through their station-meters and pressure-gauges not being kept in working order.

Mr. Milne asked what Mr. Methven considered the minimum number of consumers to justify the erection of gas-works.

Mr. Methven said that depended upon circumstances. In some places the consumers were in a better pecuniary position than in others, and would burn more gas. There were some villages where there were perhaps 50 consumers, and the whole receipts for gas did not amount to £80 a year; and in another place, where there were only the same number of consumers, the works might pay very well. He believed that if £2000 worth of gas a year could be sold the works would pay.

Mr. Livesey thought it was a pity that there were not the directors of some small gas-works present. He had often seen advertisements in the papers for managers for small gas-works, but the pay was so bad that good men would not accept the situations. One of his labourers told him that he had been receiving 23s. a week as manager of some small works in the country, and that he complained about the salary, and the directors raised his pay a shilling a week, and then announced the fact in the local journals, thinking that they had done a very liberal thing. He believed that it was not the fault of the managers of small works that the works were not more profitable. The directors employed men who had never had any proper training, and good men would not undertake the office. Some of the members of this association might perhaps have influence with the directors of small companies, and, if they would exercise it, they would be conferring a benefit upon a very deserving class of men—those who managed these works.

The Chairman remarked that perhaps it would benefit them to send them a copy of Mr. Methven's paper with the discussion upon it.

Mr. Warner regarded the question as really a very serious one. He believed that if the members of the "gas world," as it was called, were ever to rise to the position which was due to their profession, they ought to take a firm stand upon their rights. It had been said very truly that there were manufacturers of apparatus for the production and supply of gas who stepped into the shoes of gas engineers instead of acting under them. He thought that such manufacturers ought to be excluded from having any work which engineers might have to give. It was not the gas managers or gas engineers who did the harm, but these small contractors; he would not say all of them, for no doubt some manufacturers of apparatus possessed as much practical knowledge as many of the engineers in the room; but there were many men of an inferior class who styled themselves "gas engineers," and a great deal of harm was done both to the profession and to the public by such people. In one case which had come under his notice where works had been erected by a person of this sort, and had failed to be productive, it was found on stripping the mains that there was hardly a joint sound. In another case, a few months since, he had seen that a gasholder, to make it work, had had planks put all round it; and in a third instance, in which the manager of some large works was called in to investigate the cause of a failure, it was found that hardly a meter in the place worked properly. Gas engineers and managers ought to resolve that they would not patronize contractors who supplied apparatus.

Mr. Garnett said he could not concur in the opinion expressed respecting apparatus manufacturers, for, as the result of a large experience extending over many years in the south of England, and knowing also a great deal about the country generally, he had come to the opinion, which he was free to confess, that gas managers and engineers, as a body, were under very great obligations to the manufacturers of apparatus. He believed the evil was that they had not hitherto educated themselves up to the position they had ventured to assume. If they would themselves take good care that they were so thoroughly grounded in the basework of their profession, and would study all the questions that were likely to come before them in all their ramifications, they would be able to take a much higher stand than they had yet done. As a rule, he feared they had not paid that careful attention to these qualifications they should do, and on this account they too often found fault with their directors, when, to a considerable extent, the fault was in themselves. He believed that, speaking generally, gas managers derived a large amount of information from the manufacturers of gas apparatus. He would ask, did managers, as a rule, make their own plans, specifications, and detail drawings for gasholders? No; he ventured to assert they did not: those of them who did these things were the exceptions to the rule. And if gas managers placed themselves under such great and weighty obligations to the manufacturers of apparatus, it was hardly fair to condemn that class of persons in the way they had been condemned on the present occasion. He knew that there were manufacturers who offered to take a large number of shares in undertakings for the sake of getting orders; but he knew, on the other hand, that many of these men did the work confided to them thoroughly well. If gas managers would only take care to educate themselves, and not append "gas engineer" to their names till they were fully justified by their attainments, they would very soon command the respect and confidence not only of the directors of the concerns with which they were connected, but with the public generally, and would be

looked up to in a very different way to what they were at present. He was rather inclined to think that as a rule the directors were not so much to blame for the manner in which they carried on small gas-works. A short time ago he was called upon to send in a plan for the erection of gas-works in a small village in the south of England, of about 800 or 1000 inhabitants. He did so, and the work was executed by a respectable firm, the entire cost being £900, which included a 5 or 6 roomed cottage, boundary wall, splendid gasholder, 30 feet by 8, three retorts, a capital scrubber, two annular condensers, two purifiers, a station-meter, and pressure-governor all complete. This had been at work for two years under the management of a man at a salary of 18s. or 20s. a week. He believed that concern would do better if the proprietors would allow the manager to send a carbonizing statement from time to time to an experienced engineer, for these small concerns could not afford to pay an engineer to look after them constantly. But here was a case in which excellent works had been economically erected and were found to do well. Six miles from that place, in the course of last year gas-works, as nearly as possible of the same size, had been erected by another contractor. Three weeks after they had been in operation he found one of the wheels on the gasholder five inches off the guide-bar at the side column, the holder itself ten-sided instead of circular, and its top of such a peculiar shape that no one could describe it, and the whole of the apparatus in the same style. It was evident that in that case they might have got the work well done if they had gone to a respectable contractor, but he had ascertained that the contractor went there, offered to get the company up, to pay the expense of registration, and put down his name for so many shares. If things were done in that way, it was easy to understand how difficulties might arise. But as a rule he could hardly bear out Mr. Methven's conclusions, for it had been his lot, in the south of England, to see these small works very nicely attended to and kept in good working order.

Mr. MARTIN cited an instance of gas-works being under the management of a man who was a schoolmaster, the actuary of the savings bank, the registrar of births, deaths, and marriages, and the holder of some other appointments. The proprietors had received no dividend for some time, and the directors said they did not want dividends, they wanted light. Some of the shareholders, however, who lived out of the town, and did not enjoy the benefit of the light, seemed to want a little profit out of their investment. He (Mr. Martin) was called in to ascertain why the works did not pay. In the course of his inquiries he found that the schoolmaster did not like the work he had to do, but the directors would not let him resign. He only tested the gas by the smell. "Sometimes," he said, "I tell the man to take off the lid of the purifier, and look at the colour of the lime." "Yes," the man said, "and do you know that when I do that I am drunk for some time afterwards?"

Mr. D. HUNTER said that, from his observation and experience, he believed that inefficient and unprofitable management was often due to directors not paying sufficient to secure competent aid and advice. He held that directors should never in any way interfere with the technical management of the works.

Mr. WARNER said that as his remarks had drawn out a strong expression of opinion on the part of one gentleman, he might, perhaps, be allowed to qualify what he had said about the manufacturers of apparatus. There were, unquestionably, highly respectable manufacturers, who, from making various kinds of apparatus year after year, must have an amount of experience in their construction which a gas engineer could not possibly have. What he contended for was the exclusion of little makers of apparatus who put forward undue pretensions. Practically, gas engineers knew where to draw the line.

Mr. FRASER having had considerable experience in connexion with small works, thought that before they joined in universal condemnation of directors, they ought to see that they themselves had all those qualifications about them which they should possess as managers. He believed that directors were rather utopian than obstructive.

The CHAIRMAN, in closing the discussion, said: With your leave, gentlemen, I will add my mite of information upon the subject of the paper. I have not been largely concerned in the erection of small gas-works in England. I have had something to do in that way, but I have been extensively concerned abroad—amongst other places, in the kingdom of Denmark, which is entirely an agricultural country. There the vice which I believe is the vice of directors in England has not made its appearance. The directors there confine themselves, as I believe they ought to do everywhere, to looking well after the conduct of their officers, to providing the funds, and to seeing that those funds are properly expended. Beyond that they never interfere. Now I ask you to mark the result. There are ten gas-works, and the populations run from 20,000 at the highest down to 4000 at the lowest. The consumption of gas is exactly three-quarters of a cubic foot per head per diem on the average of the whole year. Mark how small. The cost of these gas-works has been about £150,000, and if we had not miscalculated the consumption the cost would more probably have been £120,000. The coal, which is Newcastle coal, costs exactly £1 a ton delivered. The gas is sold at a moderate rate for such a place—namely, at about an average of something like 7s. per 1000 feet, and we clear as a result, simply because there is not over-direction, 9 per cent. per annum. I am perfectly satisfied, and I think this meeting agrees with me mostly in that respect, that the great fault in England is that directors do not understand their proper duties. They deal with things which they neither know how to manage nor can be made to know how to manage. They deal with details which are properly those of a professional man. Our directors in England go about ordering everything themselves, they interfere with the direct management, and they believe in nothing except what they can find in pounds, shillings, and pence in their ledger where they cannot find the value of brains or the value of intelligent instruction. The consequence is, that the smaller works in England are almost universally unproductive, while if they were properly directed they might be made reasonably profitable. I believe the entire fault lies in too much direction, and in the directors not having recourse to any skilled person for the purpose of giving those profitable instructions which they are unable to give themselves. I think that if directors could only be influenced not to meddle with that which they do not understand, they would very soon get a great deal of money in their pockets, and I am perfectly certain that the public would be a great deal better supplied than they are.

On Wednesday evening, Dr. LETHEBY delivered the following lecture:—

ON THE COMBUSTION OF GAS FOR ECONOMIC PURPOSES.

Mr. President and Gentlemen,—At the close of the last lecture which I had the honour of delivering to this association at the meeting in Birmingham, I referred very briefly to the general phenomena of gaseous combustion, and to the principles of the economic use of coal gas. It was my intention, indeed, to have entered fully into this matter; but so much time was occupied in the examination of the chemical and physical properties of the most important constituents of coal gas, that little was left for the consideration of this part of our subject. I have therefore been requested to make it the especial subject-matter of this evening's lecture; and in order that you may follow me through the various details of the inquiry, it will be necessary to pursue it from the beginning.

The phenomena of visible combustion are always the results of energetic chemical action; and the heat and light which characterize it are the consequences of the violent collisions and rapid trembling of the combining atoms. When this collision occurs by the showering down, as it were, of gaseous atoms upon a solid, as you here see in the combustion of carbon and of iron in oxygen gas, and of antimony in chlorine, there may be a very intense ignition of the solid, but there is no flame. On the other hand, when the conflict is entirely among the particles of gaseous or vaporous matter, or matter in a finely divided and mobile condition, the phenomena are altogether different; for although, as before, the atoms or molecules of the burning body are intensely heated, yet from their mobility they give rise to that appearance called flame.

In all cases, therefore, we must regard flame as gaseous, or vaporous, or very finely divided matter intensely heated. That the particles of the gas or vapour must be themselves bodily and intensely heated to produce flame is evident from this—that when I burn hydrogen, or coal gas, or the vapour of ether, or alcohol by means or a finely divided solid, as I do here with a rosette of fine platinum wire, you see how the wire glows; but there is no flame, for the combustion is limited to the thin layer of gaseous matter which immediately surrounds the metal, and the temperature of the combustion is comparatively low. But if I raise it to a higher temperature, as will sometimes happen of itself, then the whole mass of escaping gas or vapour is thrown into a state of ignition, and it bursts into flame.

Let us pause for awhile to study the complicated nature of this phenomenon. Whenever a gas or vapour burns in an atmosphere of another gas or vapour, as we here see in the flame of the burning gas and candle, the phenomena are very complicated. At the points of contact which are now at the outside of the flame, the collision of the particles, because of their rapid chemical union, is most violent; and here, therefore, we have the highest temperature; but as a portion of the outer atmosphere penetrates for some distance into the burning gas, it extends the conflict into the body of the flame, and there finding itself in the presence of complex particles, it closes with those whose energies are most active. In this manner the hydrogen of the hydrocarbon is burnt first, and the liberated carbon, standing for a while in an ignited state, forms the luminous shell of the flame; and within, waiting for the presence of air, or rather passing out to take part in the conflict, is the unchanged gas or vapour. Every common flame, therefore, consists of at least three parts—the inner layer of unchanged gas or vapour, next the shell or cone of luminous matter, and lastly the outer shell of perfect combustion. That there is always an inner portion of gas or combustible vapour in every common flame may be proved by drawing it out with a glass tube and burning it at the end. See how I do it here with the flame of burning ether, and the same may be done with all other flames.

And now we are prepared to ask why it is that different substances burn with such different degrees of luminosity. The answer is clearly to be found in the circumstance that different substances contain, or evolve, or produce different amounts of solid particles. In all these flames of hydrogen, and sulphur, and carbonic oxide, there are no solid particles to be heated; but in this gas, and candle, and paraffin lamp, the particles of soot or carbon are very numerous; and if it so happens that the products of the combustion are also solid particles, the intensity of the light is so much the greater. Look at the splendid combustion of phosphorus in oxygen, and of magnesium in air. In both cases you will notice that the products are a white powder, every particle of which at the moment of its formation is intensely heated. It follows from this that every circumstance which increases the number of solid particles, within a reasonable limit, or which prolongs the time of their ignition, or which exalts the temperature of it, increases the light of the flame, and conversely everything which destroys the particles or lowers their temperature will also destroy the light.

If I throw the solid particles of lime into this almost invisible flame of oxygen and hydrogen, you will notice how vividly I bring out the light; and so also if I give the vapour of a hydrocarbon as benzole, which is rich in carbon, to the hydrogen by merely passing it through a tube packed with tow and moistened with naphtha, you observe how brightly the hydrogen burns. In the same way we can increase the illuminating power of coal gas by passing it into a chamber containing naphtha; and experiment shows that with common 13-candle gas the illuminating power is increased about 4·5 per cent. by every grain of naphtha to the cubic foot.

On the other hand, if I destroy the solid particles by hastening their combustion, the light of the flame is diminished. Here, with a common Argand burner, I merely increase the flow of air to the gas by lengthening the glass chimney, or by enlarging the central aperture, or by driving the gas by great pressure through small openings, and you see how I destroy the light; and worse still if I mix air with the gas, so that the particles of carbon find themselves at once in the presence of atmospheric oxygen—there is no light at all. Let me blow out the gas-flame from this Argand burner, and put a piece of wire gauze upon the top of the glass chimney. The gas will now draw in the air and mix with it before it reaches the top of the chimney, and see how the light is destroyed. The same is the case with this burner of Professor Bunsen. It is a metal tube of 5 or 6 inches in length and from ¼ to 1 inch diameter; the gas is admitted through a small aperture at the bottom of the tube, and just below this point there are four or five openings for the admission of air. As the gas issues from the jet and passes up the tube, it draws in the air, and this, mixing with the gas, burns at the top of this tube without any light, but with great heat. This indicates to us the disadvantage of allowing air, even in small proportion, to get into the gas; in fact, experiment shows that with common 12-candle gas the loss of light with different proportions of air will be as follows:—

Loss of Light from Air in Gas.

Per cent. Air.	Loss per cent.	Per cent. Air.	Loss per cent.
1	6	8	58
2	11	9	64
3	18	10	67
4	26	15	80
5	33	20	93
6	44	30	98
7	53	40	100

The practical conclusions from these inquiries are, that gas must be burnt with such a proportion of air as that, on the one hand, the particles of carbon shall be intensely heated, and shall remain as long as possible in an ignited state, and, on the other hand, they must not escape unburnt.

The difficulties in arriving at these results are almost insuperable, for every illuminating agent has its own particular conditions, and requires its own especial appliances to bring out the fullest effects.

Take, for example, the effect of different kinds of burners, each burning at its best, with the same gas (13 candle).

Relative Luminosity of different Burners, calculated for the same Consumption.

Kind of Burner.	Pressure at Burner.	Relative Value per Foot Gas.
Single jet	0·50	100
Fishtail	0·25	146
Bat's-wing	0·18	153
Argand	0·17	198
Bengel	0·13	214

Again, the same kind of burner, but of different sizes, will give different values.

Relative Luminosity of Jets of different Sizes, calculated for the same Consumption.

Size of Jet, Inch.	Pressure at Burner.	Relative Value per Foot Gas.
0·040	0·87	100
0·056	0·35	120
0·083	0·12	136
0·100	0·04	150
Fishtails.		
0·036	0·47	100
0·045	0·39	194
0·056	0·24	293
0·062	0·39	319
Bat's-wings.		
0·008	1·19	100
0·012	0·49	184
0·016	0·24	232
0·020	0·16	293
0·024	0·11	313
0·028	0·09	322
0·032	0·07	316
0·036	0·04	310
0·040	0·03	307

Argands of 15 Holes and 7-inch Chimney, consuming 5 Cubic Feet of Gas per Hour.

Size of Inner Hole.	Pressure, Inch.	Relative Value per Foot Gas.
0·70	0·66	100
0·57	0·46	108
0·48	0·17	117
0·44	0·17	120
0·43	0·17	115
0·42	0·17	110

And, again, the same burner with different pressures, and therefore different rates of consumption, will give different values, when calculated for the same quantity of gas.

Relative Luminosity of the same Jet (0·04 in.) at different Pressures, calculated for equal Consumptions.

Consump. per Hour, Cub. Ft.	Pressure, Inch,	Relative Value per Foot Gas.
0·88	0·28	100
1·31	0·43	156
1·80	0·87	195
2·33	1·38	240
2·83	1·97	264
3·53	2·68	270
Fishtails (0·03 in. holes).		
2·00	0·17	100
3·00	0·34	109
4·00	0·50	111
5·00	0·74	110
6·00	1·00	95
Bat's-wings (0·015 in. slit).		
2·00	0·13	100
3·00	0·21	109
4·00	0·29	135
5·00	0·45	128
6·00	0·53	122
7·00	0·68	121
Sugg's Argand 15 Holes (0·45 Internal Diameter; Hole 0·05 in).		
2·0	0·04	100
3·0	0·08	143
4·0	0·12	185
5·0	0·17	202
5·5	0·18	201
6·0	0·19	196

And so, also, with cannel gas, although in many cases the variations are not so great as with common gas, yet they are sufficiently considerable to be serious. This is seen by the following table, which I have drawn up from the experiments of Mr. King, of Liverpool:—

Relative Illuminating Power of Cannel Gas, when burnt from different Burners, and in different Quantities from the same Burner.

Power in sperm candles (120) per foot of gas.

Kind of Burner.	1 Foot per Hour.	2 Feet per Hour.	3 Feet per Hour.	4 Feet per Hour.	5 Feet per Hour.
Single jet	2·64	..	..	..	—
Lancashire fishtail (No. 2).	3·23	3·59	3·66	..	—
do. do. (No. 4).	3·59	3·95	4·11	4·0	—
London do. (No. 2).	3·49	3·61	3·89	3·85	—
Bat's-wing	3·09	3·76	4·05	4·11	4·16
Sixteen-hole Argand	0·26	1·74	2·43	3·53	3·68
Winfield 28-hole Argand	0·28	2·04	3·09	3·57	3·77

What, then, is to be done in the apparent confusion of all these facts, and can any useful generalization be made of them?

In the first place, we perceive that, of all kinds of burners, the single jet is the least effective.

Secondly, we notice that, although the bat's-wing and fishtail burners are not subject to so great variations in power as others, and are therefore best suited for common use, yet they require certain precautions to be fully effective. The best burners are those which consume from 3 to 5 cubic feet of gas per hour, and the slits and holes should be so graduated that the gas issues at a pressure of from 0·08 to 0·12 of an inch for very poor gas (12-candle), and from 0·20 to 0·40 for 14-candle gas, and from 0·4 to 0·6 inch for cannel gas.

Thirdly, we find that Argand burners are only fit for gas of less than 18 or 19 candle power. For very poor gas (up to 13-candle), the best form of Argand burner is the porcelain Argand of France (the Bengel), which has the following measurements:—

Bengel Burner (Argand) of 30 Holes.

Total height of burner	3·150 inches.
From gallery rest to top	1·220 „
External diameter	0·886 „
Internal do.	0·354 „
Diameter of circle of holes	0·650 „
do. of holes	0·024 „
Height of glass	7·87 „
External diameter of do.	2·00 „

The flame is protected from currents of air by a cage or basket of porcelain below, which is pierced with 109 holes of the 0·118 of an inch in diameter. This burner requires a pressure of from 0·15 to 0·25 for the proper consumption of the gas, and the rate at which it burns never exceeds 3·5 cubic feet per hour. This is the standard burner for France, and, compared with the best English burners, the value of the light for 5 cubic feet of 13-candle gas is as 113 is to 100.

In this country the best form of Argand burner is the 15-hole steatite burner of Mr. Sugg. The measurements of it are as follows:—

Sugg's Steatite (Argand) of 15 holes.

Total height of burner	3·00 inches.
From gallery rest to top	1·10 „
External diameter	1·10 „
Internal „	variable, according to quality of gas.
Diameter of circle of holes	0·80 „
Diameter of holes	0·06 „
Height of glass	7·00 „
External diameter ditto	2·00 „

The flame is protected by a perforated metal disc placed under the gallery, the perforations being 0·08 inch in diameter, and 8 in the inch linear.

The diameter of the inner hole or air-channel should vary according to the power of the gas, thus:—

For 12-candle gas	0·44 inch.
„ 14 „	0·48 „
„ 16 „	0·55 „
„ 18 „	0·60 „

All these Argands have the holes the 0·06 of an inch diameter, and the pressure is only 0·07 of an inch instead of 0·17, as with the old Sugg of 0·04 diameter. Above 18 candles the bat's-wing is the best burner for educing the light, and it should be regulated from 4·5 feet to 4 feet, according to the richness of the gas. And now, before I leave this part of the subject, I will show you some of the contrivances which have been proposed for increasing the illuminating power of a poor gas.

You have already seen that the single jet gives proportionably less light than the double jet or fishtail, and this is because of the larger surface of the flame exposed to oxidation. In this experiment, when I bring the jets together, you will notice how the light is at once increased, the proportion of increase being shown in the diagram.

Relative Illuminating Power of Jets separate and together.

Size of Jet, Inch.	Pressure, Inch.	Relative value per Foot Gas. Separate.	Together.
0·067	0·24	100	164
0·083	0·20	100	190
0·100	0·12	100	184

But the pressure may be such as to spread out the flame too much, and then it is over-oxidated. To check this there are the contrivances of Hart, Williamson, and others, which are fishtail burners attached to a box stuffed with wool, or having a small aperture within, as compared with the aperture, without. This offers resistance to the flow of the gas, and by making it tail a little it thickens the flame and brightens the light; but the same effect would also be produced by altering the tap, provided the tap is placed, as it always should be, at a distance of about 18 inches from the burner: in fact, if it is nearer than this, as is generally the case, there is no space or chamber for the equalization of the pressure, and the gas always burns at a disadvantage.

Again, there are contrivances on the outside of the burners—as caps, and rings, and thickenings of the top of the jet—whereby the flow of air to the gas is checked and oxidation diminished.

Even with the Argand burner, if the gas is over-oxidated, as by burning it with too large an inner aperture, or with too high a chimney, or at too small a rate, the light is improved by checking the draught of air; and this may be done, as you see, by putting a cap of wire gauze over the chimney. In fact, the whole of these contrivances have for their object such an adaptation of the gas to the air, or the air to the gas, as that the flame is just short of smoking. Under these circumstances, the solid particles remain as long as possible in an ignited state, and yet at last they are perfectly consumed.

And now I am anxious to draw your attention to the effect of rarefying the atmosphere, for it has been noticed that the intensity of a flame is much less at high altitudes than at low. This was particularly observed by Dr. Frankland and Professor Tyndall in the autumn of 1859, when they were making experiments on the combustion of candles at the top of Mont Blanc. They noticed that although the candles burnt at the same rate as they did in the valley of Chamounix, yet the flames were blue, and large, and feeble Dr. Frankland was so much struck with the phenomenon that he afterwards made it the subject of careful investigation. He found, indeed, that a gas-flame, like that of a candle, gave less and less light with the rarefaction of the air in which it was burning; and his results show that the loss of light is about 5·1 per cent. for every inch of diminished mercurial pressure, up to a rarefaction of 14 inches. If, for example, the light of a flame be equal to 100 at 30 inches of the barometer, it is but 94·9 at 29 inches, and 89·8 at 28 inches; and so on up to 14 inches, when it is only 18·4 per cent. of the original light. Fortunately, in our photometrical inquiries the loss of light is equally great with the gas and the standard, or the variations of atmospheric pressure from day to day, or even from hour to hour, would show a marked difference in the value of the light. As it is, a variation of 3 inches of the barometer must cause a difference of more than 15 per cent.; and it is not improbable that this may have something to do with visible variations in the light of the public lamps. Certain it is that the same gas in places at different altitudes will have very different values. The gas, for example, which in London has the value of 100, would be but 91 at Munich, and only 61·5 in Mexico. Indeed, the difference would be greater than this, for not only is the light actually less for equal consumptions, but as the volume of the gas expands with the rarefaction and temperature, the real value of the same quantity of gas as measured by the meter in Mexico would be only 46·2. Even in London

the difference in the value of the light when the barometer is 31 as compared with what it is at 28 is fully 25 per cent.; and it may well be that this difference is noticeable.

If the rarefaction of the gas and air are carried to a very great extent they cease to burn. The flame of coal gas, as well as that of a candle and of spirit of wine and ether, is extinguished at a rarefaction of about 1-6th of the atmosphere; hydrogen, at 1-7th; sulphur, at 1-15th; and phosphorus, at 1-60th. On the contrary, if the atmospheric pressure is increased, the luminosity of a flame is also increased, and it would seem that up to considerable pressures the rate of increase is in the observed proportion of 5·1 per cent. for every inch of mercurial pressure; and by doubling the atmospheric pressure the light of a gas-flame rises from 100 to 252. So marked is this on the luminosity of flame, that it is not difficult to make a spirit-lamp glow like a candle, or even to make it smoke.

And then there is another circumstance which influences the light of a flame, namely, the temperature at which the combustion is going on. If the temperature is lowered, the light is also proportionally diminished. This is noticed in the flame of a candle which requires snuffing, when the charred wick and the head of sooty carbon radiates the heat and lowers the temperature of the flame. But if by any means the temperature is increased, an opposite effect is produced. I have here a contrivance which was originally designed by Mr. Bowditch, and which has been somewhat modified by Dr. Frankland. It is a common Argand burner and glass, with another glass around it; and it is so arranged that all the air which supplies the burner must pass down between the glasses and be heated before it reaches the flame. The temperature which it thus acquires is from 500° to 600° Fahrenheit, and it passes to the flame as a sort of hot blast. The result of it is that the light for the same volume of gas is increased about 67 per cent., and for equal lights it is found that there is a saving of 46 per cent. of gas.

Illuminating Power with and without the external Glass in Sperm Candles of 120.

Consumption per Hour. Cubic Feet.	Illuminating Power without Glass.	Illuminating Power with Glass.
2·2	..	13·0
2·6	..	15·5
3·3	13·0	21·7
3·7	15·5	—

These are the results with cannel gas, but I do not find there is a like increase of power with common gas.

Lastly, there are cases where the amount of carbon in the vaporous matter is so abundant that contrivances are needed for its oxidation. All these contrivances are plans for diminishing the supply of the combustible and increasing the flow of air. In the paraffin candle the wick is adapted for a small supply of the material; and in the benzole and paraffin lamps there are caps or deflectors, with slits for blowing the air upon the sides of the flame. In the camphine lamp there are additional deflectors in the form of a central button, and a throttled chimney for directing the air upon the inside and outside of the flame; and in the Carcel lamp the oxidation is increased by the length of the chimney. In all cases, however, the points for consideration are—the best means for effecting perfect and prolonged combustion; and having attained this we have to take care that the light is not destroyed by the medium of transmission. Glass is very transparent, but yet it destroys a notable proportion of light, and when the surface is ground the loss of light is often considerable:—

Loss of Light by Glass Globes.

Clear glass destroys	12 per cent.
Slightly ground in pattern	24 „
Half ground	35 „
All ground	40 „
Opal glass	60 „

And lastly I have to refer to the methods which are adopted for estimating the value of the light of gas. These are as follows:—

1. By observing the durability of a jet of gas of a given height from an aperture of a given size.
2. By ascertaining the pressure necessary to obtain a flame of a given height from the same jet.
3. By noting the height of the jet when the gas is burning from an aperture of a given size and at a uniform pressure.
4. By ascertaining the quantity of air which is required to destroy the light of a flame burning at a given rate.
5. By comparing the light with a standard flame.

The first method of testing the illuminating power of gas was often used by the late Dr. Fyfe, of Glasgow, and when it was conjoined with another test, namely, the amount of condensation by chlorine, it was much relied on. The jet which he used had a diameter of the 1-33rd of an inch, and the flame was kept at a uniform height of 4 inches. In this way he found that a given volume of gas of different qualities burnt out in different times, thus:—

Durability of a Cubic Foot.

Common Newcastle coal gas	50·5 minutes.
Wigan cannel	57·0 „
Lesmahago	65·0 „
Wemyss	75·0 „
Boghead	81·0 „

Secondly, he further ascertained that the pressure necessary to make a gas burn from an aperture of a given size, and with a flame of a given height, was also the exponent of the quality of the gas; for the better the gas the less the pressure at which it burns, and the less also is the consumption to produce a flame of a given height. For example, with a jet 1-40th of an inch diameter, and a flame 5 inches high, the following were the rates and pressures of different gases:—

Pressure, Inch.	Consump. per Hour, Cub. Ft.	Specific Gravity of Gas.
0·6	0·67	0·841
0·8	0·77	0·729
1·0	0·86	0·552
1·2	0·94	0·595
1·4	1·02	0·551
1·6	1·09	0·515
1·8	1·15	0·486
2·0	1·21	0·461

His deductions from these results were, that the specific gravity of the gas—or, in other words, its quality—was inversely as the square roots of the pressures, and that the volume consumed in a given time was as the square roots of the pressures. He relied so much on this test, that he thought it capable of taking the place of both the meter and photometer.

The third method of ascertaining the value of gas is by observing the height of a flame at a given pressure from a jet with an aperture of a given size. This method has been adopted by Mr. Lowe, and it goes by the name of Lowe's jet. It is, as you perceive, a modification of the preceding, for a poor gas will burn with a shorter flame than a rich gas; and, by using a jet with an aperture 0·04 of an inch in diameter, and a pressure of 0·5, the flame of 14-candle gas will be just 6 inches in height.

The fourth method for determining the quality of gas is by ascertaining the quantity of air necessary to destroy its light. The best instrument for determining it is the apparatus designed by M. Erdmann, and which is called a gas-prover. It is a sort of Bunsen burner, with a contrivance for graduating the supply of air. Erdmann recommends the gas to be turned on until there is a flame of a given height, and then the supply of air is admitted until the light is destroyed. This, however, is not the proper way to use the instrument. The gas should first be turned on at a given rate—viz., at the rate of 0·84 of a cubic foot per hour—and then the quantity of air necessary to destroy the light should be read off. In this way reliable results may be obtained, for the richer the gas the more air is required.

I referred in my last lecture to this diagram, which has been prepared from the experiments of Mr. King, of Liverpool.

Illuminating Power of Gas, as estimated by Erdmann's Gas-Prover, the Gas burning at the Rate of 0·84 Cubic Feet per Hour.

	Description of Gas. Newcastle Coal.	Equal Parts Newcastle and Wigan.	Wigan Coal.	Boghead Coal.
Height of flame (inches)	1·87	2·00	2·75	5·50
Number of index prover	14·72	23·39	32·78	61·14
Relative value of do.	1·00	1·59	2·22	4·15
Coefficient of power	0·70	0·70	0·72	0·70
Illum. power (coefficient = 0·7)	10·30	16·37	22·95	42·80
do. do. by photometer	10·30	16·35	23·58	42·96
Relative values	1·00	1·58	2·29	4·17

Lastly, the common method for ascertaining the illuminating power of gas is by comparing it with a standard flame.

In this country, the standard was formerly a wax candle burning at the rate of 120 grains per hour, but the variations in the value of the light were so great, that it was abandoned; for, as a wax candle requires snuffing, it was difficult to decide when it was burning in a proper manner. After numerous experiments, extending over a year, I ascertained that, for equal consumptions, the light of wax and sperm was as 14 to 16—in other words, the power of sperm was just one-seventh greater than that of wax.

At present, the standard flame in this country is a sperm of six to the pound, burning at the rate of 120 grains per hour. But for some time past this standard has also become uncertain—first, because there has been great irregularity in the construction of the wicks; and, secondly, because the sperm is being adulterated with wax and paraffin, or both. The irregularity of the wick causes a variation in the rate of burning from 116 grains per hour to 140; and the real value of the light in the two cases, when reduced to the standard consumption of 120 grains per hour, is as 96 is to 116. The adulteration of the sperm with wax and paraffin also affects the value of the light, for the former gives 13 per cent. less light than sperm, and the latter gives 23 per cent. more light. These irregularities are becoming so serious, that we must ere long change the standard.

In France, the standard is a Carcel lamp of specified dimensions in every particular, burning refined colza oil at the average rate of 648 grains per hour. With proper precautions this standard appears to be very uniform, care being taken that the consumption of the oil is never less than 617 grains per hour or more than 679.

And now, in concluding this part of the subject, I will direct your attention to the comparative power and value of the most important illuminating agents.

Relative Value of different Illuminating Agents.

Name.	Rate of Consump. per Hour.	Illum. Power. (Sperm 120.)	Quantity = 14 Candles.
Cannel gas	4 feet	18·67	3 feet.
Coal gas	5 „	14·00	5 „
Benzole	301 grs.	4·91	857 grs.
Paraffin oil	265 „	7·11	522 „
Sperm oil	686 „	10·00	960 „
Colza oil	648 „	9·01	1008 „
Paraffin candles	122 „	1·46	1171 „
Sperm „	132 „	1·35	1440 „
Wax „	168 „	1·43	1652 „
Stearic „	140 „	1·13	1732 „
Composite „	144 „	1·08	1858 „
Tallow „	145 „	0·83	2542 „

With regard to the value of other illuminating agents, as the magnesium light, the oxyhydrogen or Drummond light, and the electric light, little can be said, as they vary so much with the consumption of the material.

In the case of the magnesium light, I find that when a wire the 100th of an inch in diameter is doubled and twisted it burns at the rate of 2·4 grains per minute, and gives the light of about 69 standard sperm candles; an ounce of the wire, therefore, is equal in light-giving power to rather more than 3½ lbs. of sperm candles. The power of the Drummond, or oxyhydrogen light, varies with the combustible used. With

Coal gas and air it is equal to	19	candles.
„ „ oxygen	29	„
Alcohol „ „	69	„
Ether „ „	76	„
Hydrogen „	153	„

And the power of the electric light varies from 650 candles to 1444, the average being about 1000.

All these agents are expensive, and they give a light which is characterized by intensity rather than by quantity, but as the light is pure as well as powerful, it is frequently used for signals and for photographic purposes, and also for theatrical illustrations.

I now pass to a very interesting part of our subject, namely, the cause of the marked differences in the colour of the flames of different substances; and in order that you may perceive the reason of this, let me remind you that a pure white light, with all the colours of the spectrum, is never obtained but by the intense ignition of solid or molten matter. This is so with the phosphorus flame, and with the magnesium, the oxyhydrogen, and the electric light. In all these cases there are particles of concrete solid matter in a state of intense ignition, but in the case of coal gas, and in that of other burning hydrocarbons, the light is never pure unless it is intensified by very energetic combustion. The reason of this is that the particles are only heated to the point of yellow whiteness; for Dr. Draper has shown that, according to the temperature, an ignited solid (as a spiral of platinum heated by the galvanic current) passes through all the tints of the spectrum from red to white, according to the intensity of the heat; and these tints and temperatures are somewhat as follows:—

Very dull red	about	970° Fahrenheit.
Cherry red	„	1500 „
Full red	„	2000 „
Dull red, white, or orange	„	3000 „
Yellow white	„	4000 „
Greenish white	„	5000 „
Bluish white	„	6000 „
Perfect white	„	7000 „

If, therefore, the temperature of combustion is not sufficiently high, the light is never pure. This is especially so with the creamy lagging flame of underburnt gas, and with the smoky flame of hydrocarbons rich in carbon, as benzole, turpentine, and paraffin; but if the combustion of these flames is intensified by a proper supply of air, the temperature of the ignited carbon is increased, and the light becomes purer and purer, so that when it is thrown upon coloured objects it displays the tints in a more or less perfect manner. Such a flame, when examined with the prism, gives a spectrum like that of solar light with all the tints of the rainbow. This is the speciality of pure light from an ignited solid. If, however, the vaporous matter does not contain solid particles in a free or concrete form, the ignition of it produces only certain tints of the spectrum, and hence its variable colours. Examined, therefore, with a prism, we see only those bands of colour which are characteristic of the flame.

I will show you this by moistening little balls of coke with the chlorides of the following metals, and then introducing them into the colourless flame of a Bunsen burner, or, better still, into that of Griffin's blast jet; and you note how different are the tints, and how they fail to illuminate certain colours of these dyed ribbons.

Chloride of sodium	gives	a rich yellow flame,
Chloride of copper	„	a deep blue-green flame,
Chloride of strontium	„	a rich scarlet flame,
Chloride of barium	„	a pale pea-green flame,
Chloride of lithuim	„	a bright crimson flame,
and a salt of thallium	„	a beautiful grass-green flame.

The chlorides are used because they are the most volatile, and they exist in the flame in a vaporous condition. These tints are so characteristic of the several metals, that they afford the most delicate means of discovering their presence; but the great fact which modern investigations have brought out is the circumstance that the spectrum of these flames consists of certain well-defined and constantly placed bands of colour. This diagram will show you the spectra of the metals which I have been using; and so true and constant are the positions and tints of these bands, and so delicate are the manifestations of them, that they become the means of discovering the merest traces of the several metals. But I must not pursue this further, except by showing you the differences in the tints of this spectrum and ribbons when examined with the pure white light of burning magnesium.

And now I will briefly describe the contrivances which are used for increasing, or rather I should say for fully developing, the temperature of burning gas. I have shown you that the light of a flame depends on the presence of ignited carbon; if, therefore, by any contrivance we can at once burn this carbon, and not permit it to stand as it were idle in an ignited condition, the temperature must be considerably increased. This is the principle concerned in all the contrivances for developing the heat of gas.

One of the simplest means of accomplishing this is to mix a sufficient quantity of air with the gas before it reaches the place of combustion; and this is easily done by putting a cap of wire gauze upon the chimney of an Argand burner, and setting fire to the gas above it. The effect of this arrangement is that as the gas passes from the burner to the top of the chimney, it draws in a quantity of atmospheric air, which freely mixes with it and burns the solid particles. The same is the case with the burner of Bunsen, which I have already described; and you will note how strongly it ignites this platinum crucible. The same arrangement is adopted by Mr. Griffin in his reverberatory furnace, which is a Bunsen's burner enclosed in a clay chamber. I have here another contrivance of the same nature called an *atmopyre*, which is used by Professor Hofmann in his furnace for effecting organic analysis. It is a hollow cylinder of baked pipe-clay pierced with a large number of small holes. When it is placed on a small fishtail burner, the gas, in issuing from the holes, draws in a sufficient quantity of atmospheric air to make it burn at all the apertures with a clear blue light; and thus the temperature is so much increased that the entire body of the numerous cylinders composing the furnace becomes almost white hot.

But we shall find that a still higher temperature is obtained by blowing air into a large volume of flame. This is the plan adopted by Mr. Herapath in this blow-pipe jet. Observe how intensely it ignites a mass of platinum wire; and by putting together a number of these jets, as Mr. Griffin has done, in this arrangement, which he calls a blast-furnace, you will perceive what a high temperature is obtained; and by surrounding the blast with a case of baked clay, so that the heat may be concentrated, the temperature is sufficiently high to melt all the common metals. As much as a quarter of a hundredweight of cast-iron can be melted at a time in one of these furnaces; and 3 or 4 lbs. of cast-iron or copper can be thus melted in fifteen minutes. Even the very refractory metals, as nickel and cobalt, can be thus fused.

And if instead of atmospheric air a jet of oxygen is used, as I will now show you, the temperature is still higher. This is the principle of Deville's furnace, which is a jet of oxygen blowing into a large flame of coal gas, and directed down upon the refractory substance; the whole apparatus being enclosed in a chamber of non-conductors. With this furnace large masses of platinum are easily melted, the platinum being placed upon a hollow bed of lime. I have seen a mass of platinum, weighing about 350 lbs., which had been melted in this manner; and I was informed by Messrs. Johnson and Matthey, the platinum assayers of Hatton Garden, that the mass required six hours for its fusion. During that time about 360 cubic feet of coal gas and the like quantity of oxygen were used; in fact, Deville found in his experiments at the *Ecole Normale*, that it required a little more than a cubic foot of gas and a cubic foot of oxygen to melt a pound of platinum. The temperature of the flame must be enormous; calculated from the thermotic powers of gas with air and oxygen, it may be said that it is equal to about 5228° of Fahr. when air is used, and 14,320° with oxygen.

The temperature of different combustibles is shown on the diagram below, and you will notice that the highest temperature produced by the various constituents of coal gas is that of acetylene, or the vapour of benzole when burned in oxygen, the heat of which exceeds 17,000° Fahr.; the lowest temperature of all the constituents is about 12,700° Fahr., the temperature of burning carbonic oxide.

On the same diagram I have tabulated the thermotic power of a great number of substances. It is expressed in the number of pounds of water raise 1° Fahr. by a pound of the substance, and when the body is capable of being converted into gas or vapour, I have also expressed it in the cubic foot at common temperatures and pressures. Hydrogen, you perceive, is the most powerful thermotic agent, and carbonic oxide is the weakest; a pound of the first of these gases will raise 62,030 lbs. of water 1°, whereas a pound of the latter will only heat about 4325 lbs. of water to that extent. Examined by the cubic foot, and considering that for every pound of water raised 1°, about 48 cubic feet of air are raised to the same extent, we may say the chief constituents of coal gas have this thermotic power:—

Pounds of Water and Cubic Feet of Air raised 1° Fahr. by a Cubic Foot of the Gas Burning in Air.

Cubic Foot of		Lbs. Water raised 1° Fahr.	Cub. Ft. Air raised 1° Fahr.
Hydrogen	heats	329	15,837
Marsh gas	„	996	47,946
Olefiant gas	„	1585	76,299
Propylene	„	2376	114,378
Butylene	„	3168	152,502
Acetylene	„	1251	60,220
Benzole vapour	„	3860	185,814
Carbonic oxide gas	„	320	15,403
Common coal gas	„	650	31,290
Cannel coal gas	„	760	36,585

From this we can determine the practical thermotic power of any of these agents. A cubic foot of common gas will heat 65 gallons of water 1°, or 6·5 gallons 10°, or 3·25 gallons 20°; so that a bath containing 250 gallons of water would require about 77 cubic feet of common gas, or 66 of cannel, to raise its temperature from 55° to 75°. In practice, however, this is rarely attained, because of the faulty construction of the heating apparatus. I find, indeed, that a bath in my own house, made by Phillips, of Skinner Street, takes nearly twice this proportion of gas to heat it, and being in a closed room the atmosphere is almost poisoned before the bath is ready; and the circulation of the hot water is so imperfect, that the top layer becomes boiling hot before the bottom of the water is warm. This is a subject which requires attention, for it is open to much improvement.

Table of the Combustion Temperature and Explosive Power of Gases.

	Per lb. Substance.			Pounds Water Heated 1° Fahr.			Temperature of Combustion.				Explosive Power.		Mechanical Power per lb.
							Open Flame.		Closed Vessel.				
	Ox. Used.	CO_2 Produced.	Air Vitiated.	Per lb. Substance.	Per Cubic Foot Substance.	Per lb. Ox. Used.	With Ox.	With Air.	With Ox.	With Air.	With Ox.	With Air.	Tons Raised 1 Foot High.
	Cub.Ft.	Cub.Ft	Cub Ft.	Lbs.	Lbs.	Lbs.	Deg.	Deg.	Deg.	Deg.	At.	At.	Tons.
Hydrogen	93·4	0·0	467	62030	329	7754	14510	5744	19035	7852	25·6	12·5	21390
Marsh gas	47·2	23·6	826	23513	996	5878	14130	4762	18351	6680	37·0	14·0	8108
Olefiant gas	40·5	27·0	878	21344	1585	6225	16535	5217	21344	7200	42·9	15·1	7360
Propylene	40·5	27·0	878	21327	2376	6220	16522	5239	21327	7177	67·3	22·5	7360
Butylene	40·5	27·0	878	21327	3168	6220	16522	5232	21327	7177	85·8	30·2	7360
Acetylene	36·3	29·1	909	18197	1251	5914	17146	5142	22006	7009	37 9	17·6	6275
Benzole	36·3	29·1	909	18197	3860	5915	17146	5142	22006	7009	113·7	52·8	6275
Carbonic oxide	6·7	13·5	371	4325	320	7569	12719	5358	16173	7225	21·8	11·7	1490
Bisulphide carbon	14·9	5·0	689	6120	1239	4845	15280	4314	20031	5917	30·2	11·6	2110
Sulphuretted hydrogen	16·7	0·0	630	7444	671	5271	13688	4388	17542	6026	28·3	12·7	2567
Cyanogen	14·5	14·5	435	6712	925	5142	13488	5028	17645	6167	35·6	17·8	2314
Common coal gas	37·5	17·6	618	21060	650	6816	14320	5228	18101	7001	29·2	14·6	7262
Cannel gas	31·0	22·0	698	20140	760	6503	14826	5121	19046	7186	38·8	18·0	6945
Wood spirit	25·3	11·8	422	9547	819	6363	11435	4641	14902	6347	40·3	15·3	3290
Alcohol	24·6	16·4	533	12929	1597	6195	13305	4831	17223	6629	46·4	16·1	4455
Ether	30·9	20·4	664	16249	3217	6158	14874	5150	19225	6953	58·6	19·0	5603
Camphine	38·9	27·8	880	19573	7134	5942	16271	5026	20953	6922	47·6	16·0	6750
Spermaceti	37·0	25·2	815	17589	...	6088	14599	4413	...	...	...	...	6065
Wax	37·7	25·6	829	15809	...	4995	12921	4122	...	...	...	...	5451
Stearic acid	34·6	24·0	783	17050	...	6061	15885	4818	...	...	...	...	5880
Stearin	34·4	14·2	527	18001	...	6143	15815	5095	...	...	...	...	6207
Paraffin	40·5	27·0	878	21327	...	6220	16522	5239	...	...	...	...	7354
Paraffin oil	40·5	27·0	878	21327	...	6220	16522	5239	...	...	...	...	7354
Rape oil	38·7	24·3	801	17752	...	6123	15830	5087	...	...	...	...	6121
Sperm oil	38·7	24·3	801	17230	...	6088	15363	4937	...	...	...	...	5941
Carbon	31·0	31·5	943	14544	...	5447	18329	3026	...	...	...	...	5015

Again, with regard to the boiling power of gas, although in good practice a cubic foot of gas should boil off about 4712 grains of water, or about 22 times its own weight, yet this is not often attained, for in an open vessel we rarely evaporate more than 2866 grains of water, or about 13 times its weight.

But the heat of the burning gas is more surely applied to the warming of rooms; for, as you will see by the table, a cubic foot of common gas will heat an apartment containing 3129 cubic feet of air 10°, and the same quantity of cannel gas will heat 3658 cubic feet to the same extent. Other illuminating agents will, however, light for light, heat the atmosphere, and vitiate it to a larger extent. This is seen in the table which I brought under your notice at the last lecture.

Heating and Vitiating Effects of Different Illuminating Agents, when Burning so as to give the Light of 12 Sperm Candles.

	Lbs. Water raised 1° Fahr.	Oxygen consumed, Cub. Ft.	Carb. Acid produced, Cub. Ft.	Air vitiated, Cub. Ft.
Cannel gas	1950	3·30	2·01	50·2
Common gas	2786	5·45	3·21	80·2
Sperm oil	2335	4·75	3·33	83·3
Benzole	2926	4·46	3·54	88·5
Paraffin	3619	6·81	4·50	112·5
Camphine	3251	6·65	4·77	119·2
Sperm candles	3517	7·57	5·77	131·7
Wax „	3831	8·41	5·90	149·5
Stearic „	3747	8·82	6·25	156·2
Tallow „	5054	12·00	8·73	218·3

The vitiating effect is calculated on the actual loss of oxygen, and on the power which 4 per cent. of carbonic acid has on the vital qualities of the atmosphere; and, although the results indicate that there should be less discomfort in a room lighted with coal gas than with any other illuminating agent, yet common experience is altogether in the opposite direction. The explanation of this is to be found not only in the fact that gas is used more lavishly than other agents, but also that in burning it produces a larger proportion of aqueous vapour, which becoming diffused into the surrounding atmosphere occasions great discomfort. Professor Tyndall has shown that the molecules of aqueous vapour are endowed with a remarkable power of absorbing the radiant heat of burning gas, and by thus becoming warm they create a sense of oppression; and again, when the warm atmosphere of a room is overcharged with moisture, it checks the action of vaporous or insensible perspiration, and this also causes distress. In all cases, therefore, where gas is largely used in rooms, provision should be made for the quick removal of the products of combustion.

When the heat of gas is required for warming a room, its radiant power should be increased by allowing it to ignite some solid substance, for the radiant heat of a non-luminous flame is very insignificant. I have here a Bunsen's burner, which gives with this gas the highest temperature of combustion, but the amount of heat which radiates from it is very small—smaller indeed than is the case when the gas is burnt in the ordinary way, when every atom of ignited carbon becomes a centre of radiation. The proportions of radiant heat from the same flame under different circumstances is very variable. From Bunsen's burner it is only 12, from the same gas burnt as a luminous flame it is 30, and with a spiral of platinum in it it is 85. The introduction of solid matter into a non-luminous flame of high temperature changes its character altogether, and from the heat of convexion it becomes heat of radiation. No doubt the quality of the vibrations is greatly changed, and they pass from the large and comparatively slow undulations of obscure heat to the small and quick vibrations of light; and the more this is effected, the greater and greater becomes the intensity of the radiant heat. Professor Tyndall found that the following were the quantities of radiant heat from a platinum spiral, at different degrees of luminosity:—

		Degrees of Heat radiated.
Platinum spiral	Feebly red	19
do. do.	Dull red	25
do. do.	Full red	62
do. do.	Orange red	88
do. do.	Yellow red	158
do. do.	Yellow white	200
do. do.	Blue white	276
do. do.	Intense white	440

So that, when we wish to economize the radiant heat of burning gas, it is best to use it with some solid body, as fragments of pumice or pieces of asbestos.

The last point to which I would refer is the available or convertible motive power of burning gas.

The calculations of Dr. Mayer, of Heilbronn, and the experimental inquiries of Mr. Joule, of Manchester, show that the mechanical power of heat is 772 lbs., raised a foot high for the heat necessary to raise the temperature of a pound of water 1° Fahr. A cubic foot of hydrogen in burning has therefore the mechanical power of (329 × 772 =) 253,988 lbs.; and the same quantity of common gas has the power of (650 × 772 =) 501,800 lbs.; while the power of a cubic foot of cannel gas is (760 × 772 =) 586,720 lbs., raised a foot high. But, if the same quantity of these gases is exploded with air or oxygen in a closed chamber, the mechanical power is somewhat different. I have here tabulated the expansive force of such a mode of combustion, and I may say that the calculations are deduced from the temperatures of combustion and from the volumes of the products—allowance having been made for the specific heats of the several products. It would seem, therefore, that the explosive powers of the several constituents of coal gas, when mixed with their proper proportions of air or oxygen, are as follows:—

Explosive Power of Mixed Gases.

	Mixed with Air. (Ats.)	Mixed with Ox. (Ats.)
Hydrogen	12·5	25·6
Marsh gas	14·0	37·0
Olefant gas	15·1	42·9
Propylene gas	22·5	67·3
Butylene gas	30·2	85·8
Carbonic oxide	11·7	21·8
Common gas	14·6	29·2
Cannel gas	18·0	38·8

These are the theoretical pressures exerted upon the sides of the containing vessel when these several gases are exploded with their proper proportions of air or oxygen; but as the explosion is never instantaneous, but proceeds from particle to particle, and therefore occupies time, and as the walls of the vessel always cool the products of the exploded gas to a great degree, this theoretical value is never obtained in practice, the highest pressure in the exploding chamber of a gas-engine being only 75 lbs. on the square inch, or five atmospheres. The power of this has been determined experimentally by Mr. Evans, who informs me that with a cubic foot of a mixture of nine air and one gas he has propelled a wooden shot (three inches by four) 50 yards; and he ascertained that the same effect was produced with an ounce of gunpowder. The motive power, therefore, of the exploding mixed gas is considerable.

In the gas-engines of Lenoir it has been found that the best proportions of air and gas are eight volumes of air to one of common gas; theoretically the best proportion for London (13-candle) gas is 5·6 volumes of air to one gas. A larger portion of air is required for cannel gas, as 11 to one; but in practice it is found that cannel gas does not produce so good an effect as common gas. The time of the explosion is about the 27th part of a second, and the temperature of it is about 2474° Fahr. instead of from 5228° to 7000°—the calculated temperatures for open and closed chambers.

The machines which are used for practically employing this power are all modifications of the original engine of Lenoir. They consist of a cylinder with a double-action piston, receiving the mixed gas alternately on either side of the piston. The arrangement is such that in the movement of the piston the air and gas, in proper proportions (eight to one), are drawn into the cylinder by a suitable side valve, and when the piston has made half a stroke it shuts off the valve; at that moment the mixed gas is fired in the cylinder by means of an electric spark from a Ruhmkorff's coil passing between the points of two wires in the cylinder. One of these wires is insulated by traversing a rod of porcelain fixed in the cylinder, and, being in connexion with a make-and-break contrivance, called a distributor, attached to the fly-wheel of the engine, it receives the charge of electricity, and so fires the mixed gas at the right moment. The expansion caused by the explosion and heat of combustion drives the piston through the rest of the stroke, and it generally ends with a good deal of unutilized pressure. In one case I find that the indicator recorded an initial pressure of 75 lbs. on the inch at the moment of explosion, and a final pressure of 25 lbs. The loss of power in this case must have been considerable, for not only is there the loss of the difference (12·5 lbs.) between the calculated pressure 37·5 lbs. (75÷2), and the real (25), but there is also the total loss of the unavailable final pressure. A part of this loss is no doubt due to leakage, and to the cooling effect of the walls of the cylinder, for the temperature has been observed to fall from 2474° Fahr. at the moment of explosion to 1438° at the end of the stroke—the calculated temperature being 2156°; indeed the management of the temperature is one of the difficulties of the engine, for the cylinder has to be cooled by a stream of water. Improvements will no doubt be made in the construction of the engines, and especially in the utilization of the residual power, and this must be done by shutting off the valve and firing the gas earlier in the stroke. This has already been done to some extent in America with engines of half-horse power, as with cylinders of 4⅜ inch diameter by 8¾ inch stroke; and this with 185 revolutions or 370 explosions in a minute raises 16,280 lbs. one foot high in a minute. In France and in this country much larger engines are made, as from 1 to 3 horse power.

The quantity of gas used in the working of the engine is rather variable. In the American engine, already alluded to, it took 105 cubic feet of gas an hour to work an engine of half-horse power, and a one-horse engine in London takes about 185 cubic feet of London gas—say it is 200 cubic feet—per horse power. This is 1,980,000 lbs. a foot high; whereas the theoretical power of 200 feet is more than 100 millions of pounds.

The advantages of the engine are very great, for it takes up but little room, it is very clean, it works with great regularity, it requires little or no attention, and it costs nothing for fuel when it is not at work.

One thing I ought to mention in speaking of the explosive power of mixed gas, and that is the effect of using mixtures in improper proportions. Sir Humphrey Davy found, in his experiments with marsh gas, that there was but one proportion of air and gas which gave the maximum effect, and that was a mixture of 1 of gas and 7·5 of air (theoretically it should be 1 to 9·5). When the proportions are reduced in either direction the mixture becomes less and less explosive, until with 1 gas and 15 air, or with equal volumes of gas and air, the mixture ceases to explode.

In the case of coal gas, although the theoretical proportions for London gas are 1 of common gas* to 5·6 of air, and 1 of cannel gas to 7·4 of air, yet

	Common Gas.	Cannel Gas.
Hydrogen	46·0	27·7
Light carburetted hydrogen	39·5	50·0
Olefiant, &c.	3·8	13·0
Carbonic oxide	7·5	6·8
Carbonic acid	0·7	0·1
Aqueous vapour	2·0	2·0
Nitrogen	0·5	0·4
	100·0	100·0

the best results are obtained with 1 of the former to 8 of air, and 1 of the latter to 11. On either side of this proportion the mixture rapidly becomes less and less explosive.

The effect of mixing other gases with explosive mixtures has been well studied by Davy and others: taking, for example, an explosive mixture of 2 volumes of hydrogen and 1 of oxygen, it is found that 1 of nitrogen to 6 of the gas, or 1 of carbonic acid to 7 of it, will stop its explosion.

Lastly, the temperature at which these gases are fixed is a matter of considerable importance. Davy found that he could not set fire to marsh gas (the firedamp), or to an explosive mixture of it with air, by using the strongest heat of glowing charcoal. He even blew a mixture of the gas upon glowing charcoal until he got it at a maximum heat without firing it; nor can it be fired by the sparks from flint and steel. Not so, however, with hydrogen, or olefiant gas or carbonic oxide, all of which are fired by the sparks and by glowing charcoal—perhaps the igniting temperature is about 3900° Fahr.; and the vapour of bisulphide of carbon is fired at as low a temperature as 300° Fahr. These facts are deserving of attention, for they show that gas leaking from the mains may be fired by a spark from a pick, or from the chipping of a hole in the pipe in laying a service.

And now, gentleman, we have gone over the question of the phenomena of gaseous combustion, and of the manner in which gas is to be most profitably and most economically used for illuminating purposes. We have also examined the thermotic powers of coal gas, and I hope if I have the opportunity of meeting you again, I shall be able to bring under your notice one other question of interest to gas engineers, and that is the profitable utilization of the waste products of gas-works.

The CHAIRMAN: I am sure we all feel very much indebted to Dr. Letheby for the very interesting lecture delivered to us, and particularly for his bringing before us those facts which are of most value to us in our profession. I am satisfied, therefore, that you will have much pleasure in offering to Dr. Letheby the thanks of the association.

The motion was put, and carried by acclamation.

Dr. LETHEBY: Gentlemen, I thank you for this compliment, and I will not, at this late hour, detain you with any further observations.

(To be continued.)

* *Average Composition of London Gas by Volume.*

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